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The Von Thuenen Paradigm, the Industrial-Urban Hypothesis, and the Spatial Structure of Agriculture*

MARTIN T. KATZMAN

The industrial-urban hypothesis has stimulated considerable empirical research on the spatial structure of agriculture. The alternative paradigm of von Thuenen has had almost no such impact on agricultural research, but has been the mainstay of urban economic analysis. The two models are compared as scientific theories of agricultural land use in an attempt to identify their similarities and contradictions. After reinterpreting several industrial-urban studies from a von Thuenen viewpoint, an empirical discrimination between the two models is attempted with Brazilian data. A synthesis of the two paradigms provides a better explanation of agricultural structure than either alone.

Key words: **industrial-urban hypothesis; von Thuenen; land use; regional development; Brazil.**

AS A THEORY of agricultural rent and land use, von Thuenen's *Der Isolierte Staat* [41] is nearly as venerable as that of Ricardo's *Principles* [31].[1] While in Ricardo's view *site* factors, such as fertility, determine land rent and land use, in von Thuenen's view *situational* factors are more important—i.e. the location and accessibility of the site. Rather than being logically incompatible, these explanations are special cases of a general theory of rents.

While Ricardian concepts have had a pervasive influence on both scholarly and popular thought, von Thuenen has had surprisingly little impact on even those facets of agricultural development where he would seem most applicable. This relegation to oblivion is certainly not due to lack of scholarly interest in spatial variations in agriculture. The literature on economic development is replete with such concepts as regional dualism, the core vs. periphery, growth poles, and lagging regions. The most carefully elaborated model along these lines is the "industrial-urban," hereafter IU, hypothesis, which relates agricultural to industrial development [34, 35]. This hypothesis focuses on the efficiency of markets and has been considered an institutional model, *sui generis,* with no intellectual roots in the von Thuenen, hereafter VT, tradition.[2]

Ironically, urban economics is the field where the VT paradigm has had its greatest impact and enjoyed its theoretical elaboration [1, 21, 22, 23, 25, 42]. Lampard [18, p. 83] has gone so far as to write: "The taproot of the recent flowering of urban-regional analysis lies deep in the fertile soil of Johann Heinrich von Thuenen's isolated plain with its single market center." Perhaps this notion of the "isolated city" is a forbidding vision to agricultural economists, yet it has proven useful in several historical studies of the American frontier [11, 12, 30].

The aim of this essay is to bring von Thuenen back to his rural roots. A neoclassical formulation of the VT paradigm is presented to reinterpret the IU model and to identify both similarities and contradictions between the two. The two models are then tested against evidence from earlier studies of United States agriculture which were stimulated by the IU hypothesis. Finally, an empirical test of the VT and IU paradigms is presented for a frontier region in Brazil. To the author's best knowledge, this is the first numerical presentation of the complete system of VT *agricultural* intensity gradients.

Von Thuenen's Intensity Theory: A Mathematical Version

The VT paradigm comprises a theory of crop substitution and a theory of factor substitution or

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* This study was undertaken during the author's tenure as a Ford Foundation Visiting Professor at the Instituto de Pesquisas Economicas, Universidade de Sao Paulo, Brazil. The author benefited greatly from discussions with William Cline, Ruben Almonacid, and John Sanders in the course of preparing earlier drafts, and from Anthony Tang's constructive criticism of the final draft.

[1] While von Thuenen read Ricardo's work before publishing his own, his discovery of the theory of rents was independent [15, Introduction].

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[2] Formulated by Theodore Schultz [35, 36] as the "retardation hypothesis," it has become better known as the industrial-urban hypothesis. Neither of Schultz's works contains a single reference to von Thuenen or his concepts, which cannot be an oversight because part of the former's thesis is that land rents are becoming less important as a cost component in agriculture [35, Ch. 8].

agricultural intensity. The crop theory predicts around a market center a formation of rings that specialize in the production of different staples. Here focus is on the intensity theory that describes either neoclassical factor substitution or discrete changes in systems of farming within a given ring. This latter theory would be applicable to a region characterized by the production of a single staple which is exported through a single market center.

The precise predictions of the model depend upon the type of production function assumed. As originally formulated, both the IU and VT models assume a neoclassical production function with continuous factor substitutability. The mathematical elaborations of the VT model in urban economics assume a Cobb-Douglas function, a tradition followed here.

Let some staple be produced under constant returns to scale, by three factors—land (T), labor (N), and capital (K):

$$Q = AT^{a}N^{b}K^{c}, \qquad \text{where } a+b+c=1. \tag{1}$$

Producers are profit maximizers who equate factor payments to marginal revenue products. Although the wage (w) and interest on capital (i) are considered exogenous and invariant in most formulations of the VT paradigm, this assumption is modified below. The rent (r) on land will vary with location and is determined endogenously:

$$r = a \cdot \frac{Q}{T} \cdot p \tag{2}$$

$$w = b \cdot \frac{Q}{N} \cdot p \tag{3}$$

$$i = c \cdot \frac{Q}{K} \cdot p. \tag{4}$$

Following Muth [25], these equations are translated into natural logarithmic form to facilitate the derivation. Denoting logarithmic variables with an asterisk and rearranging the above, one has:

$$Q^* = A^* + aT^* + bN^* + cK^* \tag{5}$$

$$T^* = a^* + p^* + Q^* - r^* \tag{6}$$

$$N^* = b^* + p^* + Q^* - w^* \tag{7}$$

$$K^* = c^* + p^* + Q^* - i^*. \tag{8}$$

Substituting equations (6)–(8) for T^*, N^*, and K^* in equation (5), one obtains

$$\begin{aligned} Q^* &= A^* + a(a^* + p^* + Q^* - r^*) \\ &\quad + b(b^* + p^* + Q^* - w^*) \\ &\quad + c(c^* + p^* + Q^* - i^*) \\ &= A^* + aa^* - ar^* + bb^* - bw^* + cc^* \\ &\quad - ci^* + (a+b+c)p^* \\ &\quad + (a+b+c)Q^*; \end{aligned} \tag{9}$$

thus because $a+b+c=1$,

$$\begin{aligned} ar^* &= A^* + aa^* + bb^* - bw^* \\ &\quad + cc^* - ci^* + p^* \end{aligned}$$

$$r^* = \frac{A^* + aa^* + bb^* + cc^*}{a} - \frac{b}{a} \cdot w^* - \frac{ci^*}{a} + \frac{p^*}{a}. \tag{10}$$

Note that rent is a function of a constant term reflecting the parameters of the production function, the wage, interest on capital, and the staple price. Factor proportions are derived by subtracting (6) from (7) and (8) and solving for r^*:

$$\begin{aligned} N^* - T^* &= b^* + p^* + Q^* - w^* - a^* \\ &\quad - p^* - Q^* + r^* \\ &= b^* - a^* - w^* + r^* \\ &= b^* - a^* - w^* \\ &\quad + \frac{A^* + aa^* + bb^* + cc^*}{a} \\ &\quad - \frac{b}{a} \cdot w^* - \frac{ci^*}{a} + \frac{p^*}{a} \end{aligned}$$

$$(N/T)^* = b^* + \frac{A^* + bb^* + cc^*}{a} - \frac{(a+b)w^*}{a} - \frac{ci^*}{a} + \frac{p^*}{a} \tag{11}$$

$$\begin{aligned} (K/T)^* &= c^* - a^* - i^* + r^* \\ &= c^* - a^* - c^* \\ &\quad + \frac{A^* + aa^* + bb^* + cc^*}{a} \\ &\quad - \frac{b}{a} \cdot w^* - \frac{c}{a} \cdot i^* + \frac{p^*}{a} \\ &= c^* + \frac{(A^* + bb^* + cc^*)}{a} \end{aligned} \tag{12}$$

$$-\frac{b}{a}\cdot w^* - \frac{(a+c)i^*}{a} + \frac{p^*}{a}\cdot$$

Yields are obtained by substituting the right-hand side of (10) for r^* in (6).

$$Q^* - T^* = r^* - p^* - a^*$$

$$= \frac{A^* + aa^* + bb^* + cc^*}{a}$$

$$-\frac{b}{a}\cdot w^* - \frac{ci^*}{a} + \frac{p^*}{a} - p^* - a^*$$

$$(13)\quad (Q/T)^* = \frac{A^* + bb^* + cc^*}{a}$$

$$-\frac{bw^*}{a} - \frac{ci^*}{a} + \frac{(b+c)}{a}\cdot p^*.$$

This conventional neoclassical model is now incorporated into the von Thuenen paradigm. Assume that production takes place in a uniformly fertile plain in which exists a market center. The staple must be shipped to this market in order to be sold. To simplify matters, assume that the demand curve facing the region is infinitely elastic.

The net price received by a farmer equals the market price less transport costs from farm to market. Shipping the staple to market from greater distances entails higher costs. At some critical distance from the market, transport costs are so high as to exhaust the entire price of the staple, net of labor and capital costs. Beyond this point, commercialization of the crop becomes uneconomical.

Long distance transportation costs tend to increase with distance at a decreasing rate [14, 20]. For simplicity, price received by farmers at distance k from the market can be represented as a negative exponential function of market price P_o:

$$(14)\qquad P_k = p_o e^{-gk},$$

or

$$(15)\qquad P^*_k = p^*_o - gk.$$

Now assign all variables a spatial subscript, reflecting distance k. Substituting (15) into (10)–(13), one obtains gradients of land rentals, factor proportions, and yields. Holding wages and interest on capital spatially invariant, the following simple relationships emerge.

$$(16)\qquad r^*_k = \text{constant} + \frac{P^*_o}{a} - \frac{gk}{a}$$

$$(17)\qquad (N/T)^*_k = \text{constant} + \frac{P^*_o}{a} - \frac{gk}{a}$$

$$(18)\qquad (K/T)^*_k = \text{constant} + \frac{P^*_o}{a} - \frac{gk}{a}$$

$$(19)\qquad (Q/T)^*_k = \text{constant} + \frac{(b+c)p^*_o}{a}$$

$$-\frac{(b+c)gk}{a}$$

Total supply from the region at price p_o can be derived by integrating the supply produced at all points. Defining supply at distance k as $(Q/T)_k \cdot T_k$, and taking the derivative with respect to k, integrate the right-hand side of equation (19) from the market center to the limits of cultivation, $\bar{k}$:

$$(20)\qquad Q = Q(p,w,i) = \int_0^{\bar{k}} Q'_k\, dk$$

$$= \int_0^{\bar{k}} Q/T_k \cdot T'_k \cdot dk.$$

Note that as long as wages are spatially invariant, so is output per worker [from equation (3)]. It is now appropriate to consider the determination of wages. In the *Isolated State* real wages within the region are considered everywhere equal, which presumes that any spatial wage differentials that arose would be quickly erased by costless migration. The paradigm includes a theory of money wages, which has been adapted to explain intra-urban wage differentials [24]: the agricultural staple is assumed to be edible, exhausting some fixed percent of the farm worker's budget. Since the price of this staple declines with distance from the market, money wages can also decline by that same percent of the price decline. For example, if workers spend 50 percent of their incomes on food, and if the price of other goods consumed does not vary with distance from the market center, then at some location where food is priced 10 percent below the market center, money wages will be 5 percent below town wages. This characterization is probably relevant to a low-income country, where food exhausts a large share of the family budget and the few manufactures imported from the city have low weight:value ratio.

This model, then, assumes an absence of real wage variations within the region, but does not say anything about the level of those wages, which is determined by the interaction of supply and demand. The demand for labor at a given wage is obtained by integrating the labor:land ratio from equation (11):

$$N = N(w,p,g) = \int_o^{\bar{k}} N'_k \cdot dk = \int_o^{\bar{k}} \frac{N'}{T_k} \cdot T'_k : dk. \quad (21)$$

Varying the wage parametrically generates a demand curve. Given a supply curve, the equilibrium real wage rate in the region can be solved.

Dynamic implications of the model

Now consider changes in some of the parameters of the VT model, notably increases in demand, improvements in transportation, and technological progress in agriculture. What is the effect of parametric changes upon the extent of the frontier, upon wages, and upon rents when the supply of labor is inelastic?

A rightward shift in the demand curve, due to increasing population of per capita income, increases the price at the market center. *Ceteris paribus,* the price increase leads to an extension of the frontier $\bar{k}$, and at every point within the frontier, an increase in rents, intensity of land use, and yields. If the supply of labor is not perfectly elastic, and hence wages are not constant, the results are somewhat different. An increased price raises the marginal revenue product of labor at every point within the original circle of cultivation. The availability of empty land within the expanded frontier, moreover, offers a high marginal physical product to labor, which induces some migration into this empty ring from the inner circle. At equilibrium, the labor:land ratio, yields, and rent within this circle will be lower than before and the marginal physical product of labor higher, raising wages even further.

Improvements in transportation reduce the friction of distance g and flatten the price gradient. *Ceteris paribus,* the frontier expands and at every point beyond the market center, rents, land intensities, and yields rise, as does total supply. When the price elasticity of demand is less than infinite, all these results do not hold. While the frontier expands regardless of the demand elasticity, wages will increase (decrease) if the elasticity of demand is greater than (less than) unity.

The level of total factor productivity A (or A^*) represents the state of technology or natural resource quality. *Ceteris paribus,* neutral technological progress (or a discovery of new fertile lands) raises the rental gradient, the intensity of land use, yields, and total supply as well as extending the frontier. If the elasticity of product demand is zero, the frontier will contract; if unity it will not change in position. What happens to wages depends upon both the elasticity of demand and the elasticity of the labor supply. Suppose the supply elasticity is zero. If the demand elasticity is infinite, the extension of the land area will raise wages faster than the increase of technological change. Labor intensity in the original circle of cultivation falls, but yields and rents still rise because of technological change. If the elasticity of demand is unity, the frontier remains stable and all factor prices remain constant, but yields rise. If the elasticity of demand is less than unity, the frontier contracts and wages drop. It is this worst of all possible worlds (inelastic demand, rapid technological change) that the industrial-urban hypothesis considers (Table 1).

The Industrial-Urban Hypothesis

The industrial-urban hypothesis attempts to explain regional disparities in agricultural income, which the VT model assumes away. The hypothesis comprises three major propositions [35, p. 147]:

(1) "Economic development occurs in a specific locational matrix; there may be one or more such matrices in a particular economy. This means that the process of economic development does not occur in the same way, at the same time, or at the same rate in different locations." There is enough international evidence on regional divergence in aggregate and per capita income growth to accept this proposition without further discussion [43].

(2) "These locational matrices are primarily industrial-urban in composition; as centers in

Table 1. Effect of changes in demand, transport costs, and total factor productivities, under conditions of inelastic labor supply

		Price Elasticity of Demand		
		0	1	∞
D	$\bar{k}$	+	+	+
	w	+	+	+
	r	*	*	*
g	$\bar{k}$	+	+	+
	w	—	0	+
	r	—	flatten	flatten
A	$\bar{k}$	—	0	+
	w	—	0	+
	r	—	0	+

* This is indeterminate *a priori* and depends upon the parameters of production function.

which economic development occurs, they are not mainly out in rural or farming areas although some farming areas are situated more favorably than are others in relation to such centers." This proposition clearly does not apply to a frontier region undertaking vigorous measures to increase supply, such as the American Corn Belt or the Brazilian coffee frontier in the nineteenth century. In those cases, a staple model of agricultural development—in which rural prosperity is the cause of industrial urbanism—is more relevant [2, 28, 29, 42]. Admittedly, this proposition applies to those times and places in which industry is the leading sector and agriculture is at best a supplier of surplus labor and at worst a drag on overall development. Without doing injustice either to the IU hypothesis or the facts, one can state that economic development is generally associated with a sectoral shift from agriculture into industry and commerce and that employment in the nonagricultural sectors tends to locate in urban centers.

(3) "The existing economic organization works best at or near the center of the particular matrix of economic development and it also works best in those parts of agriculture which are situated favorably in relation to such a center; and it works less satisfactorily in those parts of agriculture which are situated at the periphery of such a matrix." Following Ruttan [32] and Tang [40], consider four markets which may work better in urban than in rural areas: those for labor, capital, final products, and current inputs.

The sectoral shift in employment from rural to urban areas causes the demand for labor to grow faster than the supply in urban areas relative to rural areas, an effect magnified by the more rapid rural natural increase. This disproportionality between supply and demand raises urban relative to rural wages, in the short run. Suppose that rural wages were initially invariant regionally. Potential migrants from rural areas will weigh the lifetime gain in earnings from rural-to-urban migration against its economic and psychic costs. The farther a rural area is from the urban opportunities, the higher the costs of migrating and acquiring information about these opportunities. Consequently, at equilibrium the disparity between urban and rural incomes will increase with distance from urban centers.[3]

In addition, if industrial opportunities arise within a rural area, farm families located closer to the new urban center will be better able to avail themselves of these. Marginal farmers may abandon farming altogether or may supplement their income with city work. Secondary farm workers, notably children and women, are more likely to work in the urban center on a part-time or off-season basis the lower their commuting costs. Since specialized educational facilities are likely to be located in the urban center, farm children within commuting range are more likely to take advantage of them. All of these channels draw labor out of the farm sector, raising its marginal productivity. Finally, low income urban workers may be recruited for seasonal farm work, thereby lowering the cost of harvesting.

The capital markets may function more perfectly closer to the industrial-urban core because large cities have more banks, which thereby suffer greater competition, and large cities attract more savings both because the banks are more competitive and because more savings are generated there. Whatever the mechanism, there is historical evidence that interest rates in the United States have tended to vary inversely with city size and directly with distance from the New York and Boston area [9, 19, 33]. Because small loans are hard to obtain outside the local area, due to information and transaction costs, farms in less industrial-urban areas face higher capital costs.

In the markets for current inputs and final products, the more industrial-urban region tends to have a better transportation infrastructure and marketing organizations for assembling and disposing of farm products, distributing agricultural inputs, and distributing goods and services consumed by farm families. Partly because of the improved transportation system, the service area of the marketing firms is larger, permitting them to enjoy internal scale economies. Moreover, the larger service areas can support large numbers of marketing establishments, making them more competitive as well as more specialized than those existing in isolated small towns. The marketing superiority in the industrial-urban region means that farmers receive higher prices for their products and pay lower prices for their farm inputs and consumer goods.

To the extent that spatial differences in prices, wages, and interest rates reflect transfer costs related to distance, the IU hypothesis is not only compatible with the VT paradigm, but clearly within its tradition. Costs of migrating and commuting and regional interest rate differentials are obviously of this type.

The VT paradigm presented here has no

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[3] This argument follows from Sjaastad [39].

counterpart of the IU proposition that market structures are more competitive and efficient in the more highly urbanized regions. However, one of the theoretical offsprings of the VT paradigm, central place theory, reaches rather explicit conclusions about market structure which are perfectly consistent with the IU hypothesis: the number of enterprises engaged in the marketing of any good is proportional to the size of the market center; and the scale of enterprise will increase with an improvement in transportation or in the per capita income of the area served [7; cf. 40, Ch. 4].

In addition to improving the static efficiency of agriculture, industrial-urbanism may contribute to technological change. Some new farm inputs (e.g., chemicals, machines) have been invented in cities [17]. Innovations tend to diffuse through the urban hierarchy, from larger to smaller centers, and from cities to their rural hinterlands [3, 4, 17]. Furthermore, urbanism as a way of life, as a set of "modern" attitudes, may have an impact on rural areas in proportion to their proximity [16].

Comparing the predictions of the two paradigms

While the IU and VT paradigms are concerned with somewhat different aspects of reality, both have something to say about spatial variations in factor proportions, labor productivity, and yields. For example, while VT would explain the use of fertilizer in the more accessible areas by higher location rents, the IU might explain this by access to more perfect current input markets or perhaps by greater exposure to centers of innovational diffusion and modern ideas.

The IU hypothesis holds as the key access to the "locational matrices" of economic development. In testing the model, the question arises, "Access to what matrix?"—local, regional, or national centers of industrial-urbanism?

In an examination of 100 nonmetropolitan State Economic Areas (SEA), Duncan *et al.* [10, pp. 180–196] measured urban accessibility at three levels: nationally, by "population potential";[4] regionally, by distance to the nearest Standard Metropolitan Statistical Area (SMSA); and locally, by the percentage of SEA population urban. Local urbanization correlated poorly with all measures of agricultural structure. In a multiple regression, the percentage of land in farms and of farmland in crops was positively related to national accessibility, while the per acre values of land and buildings and of crops sold was negatively related to distance from the nearest SMSA.

For the labor market, access to all national opportunities is relevant to the migration decision. The opportunities for secondary and part-time workers would be adequately represented by opportunities (again weighted by distance) within the commuting range of a farm.

In the case of the capital market, access to national financial centers is relevant because interest rates may increase with distance from those centers. Similarly, for current input and product markets, access to national as well as local markets is relevant. Prices paid for farm inputs and consumer goods will be lower and prices received for farm products higher, the closer one is to the national market center. Within a region, however, farms accessible to large cities will confront a more competitive banking and marketing system.

In the VT paradigm, what is relevant is access to that market center in which total supply and demand are equated, i.e., at which the market price is set. Access to local collection points which simply transship the product to a final market reflects only a portion of total transportation costs. If the industrial-urban center is also the highest order market center, then access in the IU and VT senses is measured identically.

In Table 2, predictions of the IU model are compared to those of three variants of the VT paradigm which differ in their labor and capital supply assumptions: (b) no frictions in the labor or capital markets (classical version); (c) interest on capital and wages decreasing with access to the urban center (frontier-type region); and (d) interest on capital decreasing and wages increasing with access to the center (Piedmont-type region). A plus indicates that the dependent variable is positively correlated with industrial-urban accessibility; a minus, negatively correlated; and a zero, no correlation.

Evidence for the IU hypothesis

All empirical tests of the IU hypothesis have measured access to *county* rather than to national industrial-urban opportunities. Farms located in counties with high value added in manufacturing per capita or high shares of nonagricultural employment are considered to have good access.

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[4] "Population potential" of county i is the sum of populations of all other counties $j = 1, \ldots, n$, weighted by the reciprocal of distance d_{ij} between counties i and j; i.e., potential $= \sum_j P_j/d_{ij}$.

Table 2. Correlation between industrial urbanism and structure of agriculture

Model	real w	K/T	N/T	K/N	Q/T	Q/N	$(P \cdot Q)/T$	$(P \cdot Q)/N$	Percent land util.	Total Factor prod.
(a) Industrial Urbanism	+	+	−	+	+	+	+	+	+	+
(b) VT classic	0	+	+	0	+	−	+	0	+	0
(c) VT, $i-$, $w-$	−	+	+	0	+	−	+	*	+	0
(d) VT, $i-$, $w+$	+	+	*	+	+	*	+	+	+	0

* This depends on the numerical relationship between parameters of price, wage, and interest gradients.

Since each of these studies considers only intraregional variations in agricultural income and productivity, the neglect of national "locational matrices" is not too critical. One can interpret these county measures as proxies for access to all opportunities within the region.

In his study of the Tennessee Valley and the Southeast, Ruttan [32] found that in 1950, the income of farm families was positively related to the share of employment in the nonagricultural sector. Sinclair [37] extended this finding to the rest of the South, and Sisler [38] found that it held in all the regions of the nation except the northern Great Plains and the Far West. Contrary to expectation, farm income is higher in the less industrial-urban areas of the Pacific states. In a careful analysis, which controlled for age and education and which measured nonagricultural opportunities in a manner more relevant to farmers (share of employment in blue collar jobs), Bryant [6] defined access in terms of distance from the nearest SMSA and the size of that SMSA. He found that Ruttan's relationship could be generalized from the Southeast to the New England and East North Central states, but not to the Middle Atlantic states. Moreover, the opposite relationship held in the states west of the Mississippi—i.e., farm incomes rose with distance from the nearest SMSA.

The results for the South are consistent with the image of a chronic labor surplus region undergoing recent and rapid industrialization. It is less clear why the relationship should hold for New England and the East North Central states, since their industrialization is not recent, their rural birth rates are low, and the farm population has had considerable time to adjust to locational shifts in employment. The lack of relationship between industrial urbanism and farm income in the northern Plains may be due to recurrent droughts which weed out the marginal farmers, leaving the prosperous behind. It is somewhat puzzling why within the Pacific states, farm income should increase with distance from the nearest SMSA or decrease with the share of nonagricultural employment. At least for the way it has been operationalized, this corollary of the industrial-urban hypothesis applies best to labor surplus regions.

Regarding the Southeast, Ruttan [32, p. 48] concluded "that the major impact of urban-industrial development on median income per farm family is exerted directly through participation of members of farm families in nonfarm employment," i.e., the nonfarm income of farm families increases with urbanism. While there are problems of simultaneity and interpretation of causal direction in the regressions, the impact of urbanism on farm labor productivity is small but positive. These findings are consistent with the notion that commuting costs can inhibit complete wage equalization within a region.

What is the mechanism by which *farm* earnings are associated with urbanization? Ruttan finds that tractors per 100 workers and value of land and buildings per worker (roughly $rT + iK/N$) and value of livestock per worker increase with urbanization, a capital market effect. Surprisingly, so does cropland per worker in cotton counties, a result contrary to a classic VT prediction, which can be explained only if wages rise more steeply than rents with urban access. For livestock-tobacco counties, both tractors per 100 workers and urbanization are significantly related to farm income, the latter variable representing current input and product market effects. For cotton counties, only the former is significantly related to income.

The work of Nicholls [26, 27] and Tang [40], who focus on the structure of agriculture, clarifies further the mechanism by which industrial urbanism may increase farm income. Much of Nicholls' evidence on upper East Tennessee [26] is difficult to interpret in a VT framework because variables are reported on a per farm basis, and the paradigm says nothing about farm size. Positive correlations of industrialization with wheat yields, land values, and percentage of farm land improved are consistent with the classic VT model; and the positive correlation for total farm capital per worker ($rT + iK/N$) is consistent with that VT variation in which wages rise or interest falls with industrial-urban access.

Nicholls' study of Sao Paulo, Brazil [27] provides a greater array of evidence for comparing the VT and IU predictions. In 1940–50, this state still had an empty frontier, so that the assumption of real wages being spatially invariant or even increasing away from the major industrial centers applies. While many of the correlations between agricultural structure and industrial urbanism are consistent with both models, the predictions of the VT paradigm are refuted more often than those of the IU hypothesis (Table 3).

A defender of the VT paradigm could justifiably argue that the above studies did not really perform a proper test, for access to national rather than local markets is crucial. In the empirical example below, both access to national markets and local industrial urbanism are measured.

An Empirical Discrimination between the Two Paradigms

The "isolated city" is idealized as the sole market center in a homogeneous plain. If the isolated city were also the major industrial center, it would be impossible to distinguish the effects of market access from those of industrial urbanism. The Brazilian frontier state of Goias provides a felicitous testing ground for discriminating between the two paradigms. Physiographically, Goias can be readily partitioned into an infertile savanna comprising 80 percent of the surface area; a fertile zone of volcanic soil formerly overlaid by tropical forest, comprising about 10 percent of the area; and an equatorial zone where the extraction of forest products is the main activity. Goias can be considered as part of the outermost von Thuenen ring in South Central Brazil, specializing in the supply of nonperishables that can bear high transport costs—i.e., live cattle and rice (milled and unmilled).

Although there are several market centers in the state, the two major ones are close enough together (50 km) in this Texas-sized state (642,000 sq. km) to be considered as one.[5] For statistical purposes, the author refers to Goiania as the market center since it is the largest city and state capital. While Goiania and Anapolis are the largest industrial cities by employment and value added, neither city is primarily industrial, and manufacturing is widely scattered throughout the state. Relevant to a test of the industrial-urban hypothesis, the chosen measure of industrial urbanism is far from perfectly correlated with access to Goiania.[6]

About 5 percent of the state's product originates in the industrial sector. About 60 percent of industrial value added comprises the processing of agricultural products, the remainder providing consumer goods to the rural population, e.g., brick bread, and rum. The tight linkages between agriculture and industry can present a problem in testing the industrial-urban hypothesis. In the long run the relationship between agriculture and industry may be reciprocal.

Table 3. Correlations between agricultural structure and value added in manufacturing per capita, Sao Paulo State

Variable	1940	1950	Consistent model
Percent farmland utilized	+	+	both
tractors + trucks/ha.	+	+	both
value land + bldg/ha.	+	+	both
fertilizer + insecticide/ha.	n.a.	+	both
cropland/worker	0	0	neither
cropland + pasture/worker	0	+	IU, weak
all farmland/worker	0	—	VT, weak
machinery/worker	+	+	IU
value, nonland K/worker	+	0	IU, weak
value, land + bldg/worker	+	+	IU
value output/ha.	+	+	both
value output/worker	+	+	IU

Source: Nicholls [27, Tables 2–4].

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[5] The Brazilian government has established four "commercialization points" in the state of Goias, from which minimum prices are calculated. Of these points, Goiania and Anapolis are the major transshipment and processing centers.

[6] As a measure of industrial urbanism, the manufacturing wage bill/population is used as a compromise between Nicholls' [26, 27] manufacturing value added/population and Ruttan's [32] nonagricultural employment/labor force. A pitfall of many previous tests of the IU hypothesis has been the lack of variability in industrialization. In 1940, 1950, and 1960, the coefficient of variation among Goias counties in wage bill per capita has been .43, .55, and .77, respectively. The wage bill per capita has become more negatively correlated with distance from Goiania, as new factories concentrate in the Goiania-Anapolis-Brasilia axis: $r = -.21$ (1940), $-.28$ (1950), and $-.34$ (1960), the last two correlations being statistically significant at the .05 level, one-tail test.

(A) Agricultural production
$= f$ (distance from market, industrial urbanism)
(B) Industrial urbanism
$= f$(agricultural production)

While equation (B), similar to a central place model, is identifiable, equation (A) in its structural form is not. The reduced form of (A), however, which is a VT model, is identifiable. In his Tennessee Valley study Nicholls [26] was careful to demonstrate that industrialization was exogenous and not caused by agricultural development. Schuh [34] took Nicholls [27] to task in assuming the same for Sao Paulo, whose industrial development was financed by local agriculture and originally oriented toward local markets.

Here the identification problem can be circumvented by the following argument: industrial-urban centers may arise to perform central place functions, such as rice milling, for a wide multi-county region. Following the reasoning and practice of Nicholls [26, 27] and Tang [40], the reciprocal effect of industrial urbanism upon agriculture is localized within a single county. The area for which agricultural production is measured in equation (A) is much smaller than that for equation (B). The two equations can thus be interpreted as a recursive rather than a simultaneous system.

For the following analysis, the unit of observation is the county. Because of subsequent proliferation of counties, most of the data from the decennial censuses have been aggregated to fit the 1940 boundaries, when counties numbered 52. Observations from unpublished annual agricultural surveys were selected on a random basis. Because of the fragmentary nature of the data, evidence is drawn from scattered sources for the period 1940–1970. Unfortunately, measures of all the interesting variables are not uniformly available throughout the period.

Price gradients

By value the major export staples of Goias are rice and cattle. Most of this produce leaves in an unprocessed form, a major share of the rice to be hulled out of state, the cattle leaving on the hoof for fattening.

The farm prices of rice and raw meat are inversely proportional to distance from Goiania. Although the coefficients of determination are low, except for 1960, the negative-exponential price-distance relationship is significant. While the rice price gradient did not change significantly from 1950 to 1960, it did flatten by 1970 as did the meat price gradient (Table 4). One can now trace the impact of the price gradient on the characteristics of agriculture.

Land values

Gradients of values are estimated for all farmland in 1940–1960 (Table 5) and for four classes of land in 1970 (Table 4). For the earlier periods, fertility is represented by a dummy variable —a 1 being assigned to counties located in the fertile, tropical forest zone. For 1970 the soil classes are arable, forest (presumably virgin arable), savanna, and planted pasture (formed either from arable or cleared savanna). Regressions for 1940–1960 are performed with and without industrial urbanism as a control variable.

As predicted, land values in all cases are negative-exponentially related to distance from Goiania. Values in the forest zone were higher in 1940 and 1950, but not in 1960. This change is not too hard to understand, given the technique of "mining the soil," evidenced by low fertilizer use. The effect of industrial urbanism on land values was positive but weak.

Table 4. Distance coefficients for prices and land values[a]

	1950	1960	1970
Rice b	—.005*	—.007*	—.002*
s_b	(.002)	(.000)	(.001)
R^2	.20	.54	.12
Meat b		—.009*	—.002*
s_b		(.001)	(.001)
R^2		.37	.22
Arable b			—.006*
s_b			(.001)
R^2			.37
Natural pasture b			—.011*
s_b			(.001)
R^2			.59
Planted pasture b			—.004*
s_b			(.001)
R^2			.25
Forest b			—.010*
s_b			(.002)
R^2			.50
n	28	60	25

Sources: [4, 13].
[a] Distance in 10 km units; dependent variables in natural logs.
* Significant (.05, one-tail).

Table 5. Gradients of land values and land use

	1940			1950			1960		
	Distance	Fertility	Industrial urbanism	Distance	Fertility	Industrial urbanism	Distance	Fertility	Industrial urbanism
Land value/ha.	—.044*	.142	.324	—.026*	1.023*	.146*	—.024*	.471	.011
	(.004)	(.456)	(.221)	(.003)	(.387)	(.049)	(.003)	(.348)	(.007)
		$R^2 = .76$			$R^2 = .73$			$R^2 = .70$	
Percent land area in farms	—.010*	.085		—.089*	.057		—.072*	.161	
	(.020)	(.232)		(.018)	(.205)		(.014)	(.160)	
		$R^2 = .36$			$R^2 = .37$			$R^2 = .42$	
Percent farmland utilized	—.007*	.020		—.006*	.005		—.002	.033	
	(.004)	(.050)		(.002)	(.025)		(.003)	(.034)	
		$R^2 = .07$			$R^2 = .19$			$R^2 = .05$	
Percent farmland arable	—.003	.815*		—.007*	1.172*		—.060*	1.579*	
	(.003)	(.321)		(.003)	(.307)		(.027)	(.312)	
		$R^2 = .13$			$R^2 = .41$			$R^2 = .47$	
Percent farmland pasture	—.072*	—.420*		—.019*	—.505*		—.023*	—.401*	
	(.014)	(.168)		(.011)	(.124)		(.012)	(.137)	
		$R^2 = .33$			$R^2 = .25$			$R^2 = .16$	
Percent farmland forest	.063*	.856*		—.088*	.756*		.013	.843*	
	(.024)	(.273)		(.023)	(.320)		(.023)	(.268)	
		$R^2 = .20$			$R^2 = .19$			$R^2 = .39$	

* Significant (.05, one-tail).

The regressions for each land type in 1970 are consistent with these results. It should be pointed out that for 1970, the land value coefficients are larger in absolute value than predicted by the price gradient and production function parameters.[7] Taking the output elasticity of land in rice production as 0.7, the land value gradient (g/a) should be — .003 for farmland and forest, which is potential farmland. A possible explanation is that interest rates increase with distances from Goiania, hence the gradient of land values (r/i) is steeper than that of rents.[8] Unfortunately no pertinent information on interest rates is available.

Patterns of land utilization

Implicit in the neoclassical production function is that the marginal productivity of land is everywhere positive. If land in Goias were uniformly fertile, there should be no relationship between distance from the market and the proportion of land which is exploited *within* the frontier $\bar{k}$. In fact, one observes in the period under consideration that the proportion of county area incorporated in farms and the proportion of farmland utilized declines with distance from Goiania (Table 5). In general the share of farmland under various modes of utilization (annual and perennial crops, natural and planted pasture) declines with distance. In comparison with the savanna, the fertile forest zone has a higher share of its land area in farms, of its farmland utilized, and of its farmland in arable and planted pasture.

The explanation for these patterns must lie in fertility differentials not captured in the savanna-forest dichotomy. Suppose each savanna county has a similar distribution of soil fertility, represented by the parameter A in the production function. From equation (20), one sees that the limit of cultivation ($\bar{k}$) is directly proportional to A (or r^*). Farms further away from the market will find that it pays only to cultivate the more fertile soils, with high values of A. Hence the average quality of soil utilized increases as the share of arable and pasture decreases with distance.

Factor proportions

In Goias about 85–90 percent of farm capital was embodied in land and animal stock in the period 1940–60. Only a trivial share, about 2 percent, was embodied in machinery and vehicles. The value of all forms of farm capital per hectare is negatively related to distance, but for only machinery and vehicles does industrial urbanism exert a significant (positive) impact. The use of working capital in the form of fertilizers, seeds, and insecticides is inversely related to distance from Goiania and weakly related to industrial urbanism (Table 6).

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[7] The output elasticity of land in pasture has been estimated as zero for Brazil [8, pp. 64–71].

[8] If interest rate i increases with distance at the rate jk, then the gradient of land values ($= r/i$) is greater than that of land rents by jk; $(r/i)^* = \text{constant} - (j + g/a)k$.

The distance coefficient for animal stock seems to reflect changes in price rather than changes in quantity, as the coefficient for meat prices in 1960 (— .009) was not significantly different from that for the value of animal stock per hectare (— .006). The distance coefficient for capital used in rice cultivation (g/a) should equal — .007 in 1950 and — .011 in 1960. While it is unknown how capital is allocated by use (rice vs. cattle), the distance coefficients tend to be significantly more negative than expected. Again this suggests that the cost of capital increases significantly with distance from Goiania.

The value of capital per worker is consistently and negatively related to distance from Goiania. While the capital-labor ratio is positively related to industrial urbanism, the relationship is not uniformly significant. The inverse relationship between the value of land per man (rT/Ni) and distance is inconsistent with the Cobb-Douglas production function with constant wages and interest rates.

Equation (17) predicts that the labor-land ratio declines with distance from the market. While this ratio is higher in the tropical forest zone than in the savanna, it is unrelated to distance from Goiania.

Factor productivities

Data on output by county are rather scanty. In 1940 the value of agricultural and pastoral output per hectare was unrelated to distance from Goiania. In 1960 the gradient of output of crops per hectare (— .008) was similar to that of rice prices (— .007), but significantly smaller than expected (— .010). This suggests that price change alone, not factor substitution, is the major determinant of changes in output per hectare.

The value of output per man in 1940 was negatively related to distance from Goiania. This result is inconsistent with the Cobb-Douglas model, where wages are assumed to be constant (Table 7).

Table 6. Factor proportions

	1940			1950			1960		
	Distance	Fertility	Urbanism	Distance	Fertility	Urbanism	Distance	Fertility	Urbanism
Dollars buildings	—.015*	.585*	.218	—.017*	.744*	.098*	—.013*	.696*	.010
per ha.	(.003)	(.337)	(.164)	(.004)	(.298)	(.038)	(.003)	(.373)	(.007)
		$R^2 = .49$			$R^2 = .65$			$R^2 = .44$	
Dollars machinery,	—.009*	1.100*	.397*	—.012*	.747*	.090*	—.023*	.565	.017*
vehicles per ha.	(.004)	(.468)	(.227)	(.002)	(.286)	(.036)	(.004)	(.473)	(.009)
		$R^2 = .28$			$R^2 = .55$			$R^2 = .56$	
Dollars animal	—.008*	.411	.216	n.a.	n.a.	n.a.	—.006*	.416	.005
stock per ha.	(.003)	(.323)	(.157)				(.002)	(.294)	(.006)
		$R^2 = .26$						$R^2 = .21$	
Dollars fertilizer	—.013*	.354	.407	—.241*	2.539	—2.147	—2.866	—271.	5.34
per ha.	(.006)	(.761)	(.370)	(.127)	(15.89)	(2.015)	(1.812)	(230.)	(4.51)
		$R^2 = .05$			$R^2 = .03$			$R^2 = .05$	
Dollars land	—.044*	—.988*	.242	—.023*	—.076	.094*	—.023*	—.261	.010
per man	(.005)	(.594)	(.288)	(.002)	(.294)	(.037)	(.003)	(.331)	(.006)
		$R^2 = .63$			$R^2 = .73$			$R^2 = .65$	
Dollars buildings	—.015*	—.543	.146	—.014*	—.415*	.046*	—.012*	—.036	.009*
per man	(.003)	(.343)	(.167)	(.002)	(.217)	(.028)	(.002)	(.257)	(.005)
		$R^2 = .39$			$R^2 = .61$			$R^2 = .48$	
Dollars machinery,	—.009*	.028	.319*	—.009*	—.413*	.038*	—.021*	—.167	.015*
vehicles per man	(.003)	(.432)	(.210)	(.001)	(.162)	(.021)	(.003)	(.396)	(.008)
		$R^2 = .16$			$R^2 = .55$			$R^2 = .57$	
Dollars animal stock	—.008*	—.717*	.143	n.a.	n.a.	n.a.	—.004*	—.317	.004
per man	(.003)	(.357)	(.173)				(.003)	(.325)	(.006)
		$R^2 = .15$						$R^2 = .02$	
Dollars fertilizer	.002*	—.061	.073*	—.047*	—.213	—.436	—.569*	—20.507	.318
per man	(.001)	(.088)	(.043)	(.025)	(3.143)	(.399)	(.238)	(30.13)	(.591)
		$R^2 = .13$			$R^2 = .02$			$R^2 = .08$	
man per ha.	—.000	1.123*	.072	—.004	.804*	.052	—.002	.732*	.001
farmland	(.003)	(.379)	(1.184)	(.003)	(.303)	(.300)	(.003)	(.343)	(.007)
		$R^2 = .12$			$R^2 = .21$			$R^2 = .07$	

* Significant (.05, one-tail).

Table 7. Factor productivity

	1940			1960		
	Distance	Fertility	Urbanism	Distance	Fertility	Urbanism
agric.	—.002	—.218	.075	—.008[a]	n.a.	n.a.
output	(.003)	(.321)	(.156)	(.001)		
per ha.		$R^2 = .04$			$R^2 = .42$	
animal	—.003	.987*	.149	n.a.	n.a.	n.a.
output	(.003)	(.373)	(.181)			
per ha.		$R^2 = .16$				
agric.	—.002	—.126	.149	n.a.	n.a.	n.a.
output	(9.002)	(.280)	(.136)			
per man		$R^2 = .00$				
animal	—.008*	—.666*	.135	n.a.	n.a.	n.a.
output	(.003)	(.350)	(.170)			
per man		$R^2 = .13$				
total	—.005*	—.405*	.142	n.a.	n.a.	n.a.
output	(.002)	(.306)	(.148)			
per man		$R^2 = .05$				

[a] $n = 60$, random sample of counties.
* Significant (.05, one-tail).

An interpretation of the results

In Goias agricultural counties closer to market enjoy higher product prices, land values, capitalization, and rates of land utilization. Access to local industrial-urban centers increases the use of machinery per hectare and per man, but has little effect on other inputs.

The numerical results are often inconsistent with the neoclassical versions of both the VT and IU paradigm presented above. The following inconsistencies can be explained by a VT model in which there are fixed land and labor coefficients:[9]

(1) the labor-land ratio is unrelated to distance from market;
(2) rental gradients have the same slopes as price gradients;
(3) the value of animal capital/hectare has the same slope as the price of meat;
(4) the value of output/hectare has the same slope as the price gradient;
(5) the value of land inputs per man is inversely related to distance;
(6) the value of output per man is inversely related to distance.

The mechanism by which intensity of land use increases with proximity to the market is not factor substitution but by the incorporation of less fertile land as described above. This explanation is tested directly by regression of the labor-land ratio against the proportion of farmland in arable and in pasture, the residual being unused. Empirically, this ratio is directly related to the share of land under cultivation, but not highly related to the share in pasture. Once the land use pattern is known, moreover, distance from the market and fertility add little information. In fact, the share of land in arable is a better predictor of the labor:land ratio than these two exogenous variables.

Conclusion

The von Thuenen and industrial-urban models are independently formulated explanations of regional variations in agricultural structure and income. Ostensibly, the explicans in the VT model is access to commodity markets, in the IU, access to industrial-urban complexes. To the extent that spatial variations in commodity and factor prices reflect transfer costs, the IU model logically reduces to a VT model. The IU paradigm genuinely differs from the VT in its emphasis on market imperfections associated with monopoly and monopsony in rural areas dominated by small towns.

In an examination of a Brazilian frontier state, the spatial structure of agriculture conforms well to a VT model in which there is limited land-labor factor substitution. Predictions of the capital intensity of farming are improved when local industrial development is taken into consideration.

The evidence reviewed here suggests that a synthesis of the von Thuenen and industrial-urban models provides powerful insights into the relationship between urban and rural development. It is therefore astonishing that these two paradigms have been generally ignored in the "growth pole" literature, which presumes to explain the diffusion of developmental impulses from industrial centers. Since this literature abounds with mystical concepts not easily operationalized or translated into conventional economic vocabulary, an integrated IU-VT approach offers considerable analytical advantages.

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[9] From the fixed coefficients production function, rents $(r_k) = (p_k - wN/Q) \cdot Q/T$, where N/Q and Q/T are more or less spatially invariant. While K/T does vary with distance in the case at hand, its contribution to yields and costs is so small that it can be safely ignored.

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Optimal Advertising Signals in the Florida Citrus Industry: A Research Application*

Eithan Hochman, Uri Regev, and Ronald W. Ward

A sales response to advertising for the Florida citrus industry is estimated and used to explore optimal levels of advertising. Results of an optimal control model show the gains that can be realized through inter- and intraseasonal changes in the level of advertising expenditures. These gains are generated by using imputed prices that take into account future gains of current advertising. An optimal path of adjustment in both advertising and sales over time is obtained which provides signals for an effective advertising policy.

Key words: **advertising; sales response; Florida citrus industry; optimal control.**

Commodity advertising is fast becoming a major marketing tool in agribusiness industries. Such programs as national advertising of milk, poultry, and citrus are examples. Structural reorganization has taken place in many of these industries to facilitate national advertising programs. The organization and growth of the Florida Department of Citrus (FDOC) as an agency charged with the responsibility of promoting Florida citrus represents such an organizational change within the citrus industry. Through its generic advertising and promotion programs, the FDOC has substantial influence on the Florida citrus industry marketing efforts.

Advertising programs are designed to provide the consumer with information about the product with the ultimate purpose of increasing total consumer expenditures for the product. The decision to advertise is, however, frequently made without a clear understanding of the expected consumer response. Levels of advertising expenditures are frequently determined after observing obvious signals such as declining sales or inventory buildups. Given a quantitative understanding of the effectiveness of advertising on citrus sales, the interpretation of signals for changes in advertising policies can be improved.

A quantitative model is developed in this paper to provide signals to those responsible for setting citrus advertising policies. The model includes econometric estimates of the relationship between advertising expenditures and the consumer sales response, and optimal control tools are used to derive optimal industry advertising policies.

Empirical evidence of the influence of advertising on sales is now well documented. Quantitative analysis showing advertising influence on the sales of individual brands of a product can be found in studies such as those by Telser [13], Weiss [15], and Bass [3]. On a more aggregate level, in an econometric study of 85 industries in the United Kingdom, Doyle [5] found that the ratio of advertising to sales declined with both higher sales and prices. Another significant result is the finding by Taylor and Weiserbs [12] that inclusion of advertising in an aggregate consumption model for the period 1929–68 yielded a highly significant (positive) coefficient.

In the normative framework of deriving advertising decision criteria there is extensive literature of which two significant examples are the papers by Dorfman and Steiner [4] and by Hahn [7]. Vidale and Wolfe [14] and Nerlove and Arrow [10] were the first to consider advertising as a special type of investment, and they derived optimal advertising policies over time. Vidale and Wolfe attempted to develop a model of sales behavior through time relative to different levels of advertising expenditures. This model, consistent with their empirical observations, has three parameters: sales decay constant, saturation level, and sales response constant. Nerlove and Arrow assumed that there is a stock of goodwill measured in units having a price of $1.00 so that a dollar of advertising expenditure increases the stock of goodwill by a like amount. Gould [6] applied the adoption of a "cost of adjustment" argument to optimal advertising policy. He es-

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tablished that the optimal advertising policy is to advertise most heavily in the initial periods and continually decrease the level of advertising expenditures as the level of sales increases toward the equilibrium level.

Jacquemin [8] shows that it is not necessary to assume a nonlinear cost function in order to have the price of goodwill change over time. He maintains the linear cost hypothesis but assumes that the firm's profit is not only a function of goodwill but also of the current advertising expenditure. Jacquemin and Thisse [9] establish that the Nerlove-Arrow theorem (deriving an optimal ratio of the stock of goodwill to sales flow) is not a direct counterpart of the Dorfman-Steiner theorem (which derives the optimal ratio of current advertising expenditure to sales revenue), but is a special case of a more general expression where the price of goodwill is not assumed to be equal to unity.

In this paper an optimal control model following Gould [6] and Jacquemin [8] is combined with an econometric estimate of the sales response function in the citrus industry. In the second section a brief description of the Florida citrus industry is presented. An empirical sales response model is hypothesized and tested in the third section. Then the Maximum Principle [2, 11] is used to solve the advertising problem, given a concave sales response function. The empirical results are analyzed, and finally the results are compared with static decision criteria as well as with actual citrus advertising policy.

Advertising in the Florida Citrus Industry

Advertising by the Florida citrus industry has long been recognized as a useful marketing tool to promote Florida citrus. The formation of the Florida Department of Citrus represented an effort by the citrus industry to organize an agency to develop effective advertising strategies. The department's advertising efforts have been shown through both national generic advertising programs and through programs designed to disseminate information to firms using branded advertising. All generic programs are financed through a direct grower tax levied by the FDOC, while branded advertising represents a cost which each processor deducts from the returns paid to growers. Therefore, the effective allocation of the total dollars spent on advertising is of major concern to the citrus grower.

Although advertising programs by the industry have existed prior to the introduction of frozen concentrates in the early fifties, the general nature of these programs has changed substantially. Early efforts were highly regionalized, and multi-media and multi-copy were emphasized. Since the mid- to late sixties, however, the strategy has been to emphasize national media with less variation in the format of the copy. This is evident from the series of national television commercials centered around well-recognized celebrities. Since 1967 the strategy for citrus advertising has been to concentrate on a given theme with little variation in the copy or media used. However, the amount of advertising expenditures has varied since 1967. These expenditures are shown in Figure 1 for the periods of Fall 1967 through Spring 1972. Consumer expenditures for processed citrus products are also shown in the same figure where a seasonal sales factor is evident.

The organizational structure exists for changing the aggregate advertising levels through the direct and indirect efforts by the FDOC. However, to develop advertising programs effectively, it is essential that an empirical understanding of the sales response to advertising be known. Such empirical evidence can provide signals for advertising policy adjustments.

The use of national media for advertising generally necessitates commitments to spend funds prior to the time such programs are shown over the media. Hence, problems arising from any simultaneity between citrus sales and advertising allocation decisions are generally non-existent. Advertising may also have some carryover effect, and this must be recognized in developing advertising strategies. Finally, seasonality exists in the sales of citrus products as evident in Figure 1, and this must be considered in planning the advertising program. Given the policy concerns and data discussed above, empirical models outlining the effectiveness and optimal allocations of citrus

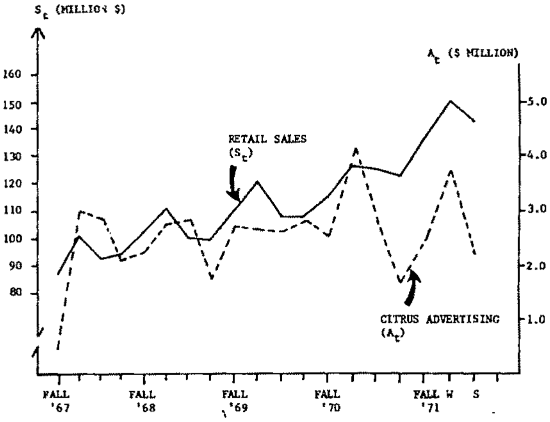

Figure 1. Florida citrus quarterly retail·sales and citrus advertising, Fall 1967 through Spring 1972

advertising dollars will be developed in the following sections.

Econometric Citrus Advertising Model

Citrus advertising through national media such as television represents a major effort by the Florida citrus industry to influence the retail sales of its processed citrus products. Such influences are manifested in a sales response over time ($\dot{S}$) where:

$$\dot{S} \doteq g(A_t, S_t, t) \tag{1}$$

and $A_t =$ advertising expenditures in period t,

$S_t =$ retail dollar sales in period t,[1]

$$\dot{S} = \frac{dS_t}{dt}.$$

On a theoretical basis, the effect of A_t and S_t can be directly hypothesized:

$$H_1\colon g_A > 0 \text{ and } g_{AA} < 0,$$
$$H_2\colon g_S < 0 \text{ and } g_{SS} < 0,$$
$$H_3\colon g_{AS} < 0.$$

Hypotheses H_1, H_2, and H_3 will be referred to as the *regularity conditions*. H_1 suggests that advertising has a positive influence on $\dot{S}$; yet the effectiveness of each additional unit of advertising should decrease. H_2 suggests that sales increments decrease at an increasing rate when the untapped market potential decreases or as the level of sales increases. This hypothesis tests the empirical observation that for a given market and any given level of advertising, bigger sales rates have the effect of slowing the rate of increase. Advertising is less effective when sales rates are higher. Finally, the marginal effectiveness of advertising should decrease as the market approaches its maximum sales potential (H_3).

An explicit functional counterpart of equation (1) can be specified under the assumption that a market saturation level (M) is given. Also, the citrus sales response follows a seasonal pattern (see Fig. 1) which must be included in the explicit function. Let[2]

$$\dot{S} = \beta_1\,[\log_e A_t]\sqrt{1 - \frac{S_t}{M}} - \lambda S_t + \beta_2 \sin\left[\frac{\Pi}{2}t - \Pi\right], \tag{2}$$

where $0 < \lambda < 1$, and $S_t \leqslant M$.

Equation (2) includes three major components. First, the advertising effect weighted by the market potential, i.e., $\left(\sqrt{1 - \frac{S_t}{M}}\right)$ satisfies hypotheses H_1, H_2, and H_3.[3] Second, the effects of advertising in previous quarters have some carryover $(1 - \lambda)$ into the present quarter as mea-

	Elasticities	Distribution of Processed Products
FCOJ	1.16	82%
COJ	1.43	5%
CSSJ	.65	13%
Total Est.	1.10	

Source: Economic Research Department, Florida Department of Citrus.

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[1] Retail citrus sales as measured by S_t include frozen concentrated (*FCOJ*), canned (*CSSJ*), and chilled (*COJ*) orange juices. The elasticity of demand from these products is approximately unitary; hence, the models used can relate sales in dollars to actual advertising expenditures without measuring the price effect. Also Florida supplies nearly all processed citrus as measured in S_t. Therefore, the effect of possible competing areas is minimal and does not enter the model.

[2] The structure of g as set forth in (2) was developed in part from a Vidale-Wolfe type marketing model [14]. However, equation (2) specifically was designed to allow the advertising effect to vary according to the amount being spent, i.e., $g_{AA} < 0$. Seasonality of citrus sales is well documented and was explicitly incorporated into the model. Although (2) satisfies the hypotheses set forth in H_1, H_2, and H_3, alternative structures were hypothesized for empirical purposes. One form included redefining the sales response as $\dot{S} \simeq S_t - S_{t-1}$.

Two explicit changes were considered in the process of estimating (2). First, the market saturation variable M was allowed to grow over time, i.e., $M_t = M * \omega_t$. A weight ω_t was estimated from an index of the number of households which are potential consumers of *FCOJ*. Second, alternative seasonal models were considered. In both circumstances no major statistical improvements over those empirical estimates of (2) were evident. Hence equation (2) was selected as the structural equation of motion to be used in an optimal control model.

[3] Changes in the total level of sales and advertising influence $\dot{S}$ as hypothesized in H_1, H_2, and H_3 are these:

$$g_A = \frac{\beta_1}{A_t}\sqrt{1 - \frac{S_t}{M}} > 0$$

$$g_{AA} = -\frac{\beta_1}{A_t^2}\sqrt{1 - \frac{S_t}{M}} < 0$$

$$g_{AS} = -\frac{\beta_1}{2A_tM}\sqrt{\frac{M}{M - S_t}} < 0$$

$$g_S = -\frac{\beta_1 \log A_t}{2M}\sqrt{\frac{M}{M - S_t}} - \lambda < 0$$

and

$$g_{SS} = -\frac{\beta_1 \log A_t}{4M^2}\sqrt{\left(\frac{M}{M - S_t}\right)^3} < 0.$$

sured by the advertising decay rate λ. If $A_t \rightarrow 1.0$, then $\dot{S}$ will decline smoothly over time according to the value of λ. This decline will be faster for larger values of λ. Finally, $\dot{S}$ follows a quarterly seasonal pattern independent of the level of sales or advertising according to the value of β_2.

The retail sales of processed citrus and the quarterly expenditures on advertising are plotted in Figure 1 for the quarters from Fall 1967 through Spring 1972. Using these data, *OLS* estimates of equation (2) for various values of M are given in Table 1. These estimates show that there is both a significant seasonal effect and a significant sales decay constant. The sign of β_1 is consistent with the hypothesized effect, and the estimate of β_1 over values of M is generally significant at the 85 percent level.[4] There are no exact criteria for selecting the appropriate M; however, $M = \$160{,}000$ gave the highest R^2 and the most significant t value for β_1. Also, as seen in Figure 1, $M = \$160{,}000$ does exceed all previous values of S_t.

As outlined in the introduction, a major concern of the citrus industry is how to spend advertising funds optimally over time. Assuming that the industry wishes to maximize its gains in allocating its aggregate advertising funds over time, the problem to solve is:

$$(3) \qquad \max \int_0^\infty [S_t - A_t] e^{-\rho t}\, dt$$

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[4] Inherent in long time series of advertising expenditure data are unmeasurable fluctuations in the nature of the advertising services purchased. Any increased degree of freedom by using long series of data can frequently only be gained at the expense of considerable variation in the nature of the services purchased. The fact that β_1 is statistically significant at the 85 percent level is extremely important since the actual advertising data used were shortened to include that portion of a time series when the actual content, copy, and media were known to be relatively constant.

Table 1. OLS estimates of the aggregate effect of citrus advertising on the change in citrus retail sales over time given various assumed levels of sales saturation (M)[a]

Equation	M ($1000)	β_1	$[1-\lambda]$	β_2	R^2	DW	n	F
(1)	140,000	1736.6 (1.575)	.9755 (27.99)	6443. (2.427)	.8195	1.842	19	36.32
(2)[b]	160,000	2138. (1.605)	.9467 (18.60)	6466. (2.441)	.8204	1.842	19	36.54
(3)	170,000	2246. (1.577)	.9363 (16.14)	6492. (2.442)	.8196	1.846	19	36.22
(4)	180,000	2312. (1.553)	.9284 (14.57)	6509. (2.441)	.8189	1.850	19	35.99
(5)	200,000	2386. (1.516)	.9168 (12.61)	6533. (2.439)	.8177	1.863	19	35.75

[a] The estimates of the model for $\dot{S}$ were estimated with OLS where

$$S_{t+1} = \beta_1 A' + [1-\lambda] S_t + \beta_2 \sin [.5\Pi t - \Pi]$$

and

$$A' = [\log A_t] \sqrt{1 - \frac{S_t}{M}},$$

$$\dot{S} \simeq S_{t+1} - S_t.$$

Both S and A were in $1000 units per quarter, and t was incremented by one per quarter starting with $t = 2$, Summer 1967. The Student t test values are given in parentheses.

[b] Multicollinearity arises as a result of inclusion of S_t in A' as well as in the decay effect as evident from the correlation matrix where

$$\begin{bmatrix} 1.0 & .94 & .1427 \\ & 1.00 & .1631 \\ & & 1.000 \end{bmatrix}$$

Correction for this problem by removing one of the variables leads to an incorrectly specified model. For the problem at hand, model specification is more important than increased precision. This is especially true since $t > 1.0$ for each parameter estimated.

subject to the sales response function (1) or explicitly, equation (2) and a given interest rate ρ. The solution of a problem of this nature is the subject of the next section.

An Optimal Control Solution for Advertising Expenditures

Applying the Maximum Principle [2, 11] to solve (3) by using the current value Hamiltonian (t subscripts dropped for convenience only),

$$(4)\quad e^{\rho t} H(S, A, \eta) = S - A + \eta \cdot g(S, A, t),$$

the necessary conditions for optimization are obtained as follows:

$$(5)\quad \frac{\partial H}{\partial A} = 0 \text{ or } \eta = \frac{1}{g_A},$$

$$(6)\quad \frac{\partial H}{\partial S} = -\frac{\partial(e^{-\rho t}\eta)}{\partial t}$$

$$\text{or } \dot{\eta} = [\rho - g_S]\eta - 1.$$

The system described by (1), (3) through (6), the regularity conditions, and the following transversality conditions,

$$(7)\quad \lim_{t\to\infty} e^{-\rho t}\eta \geqslant 0 \text{ and } \lim_{t\to\infty} e^{-\rho t}\eta\, S_t = 0,$$

furnish a complete mathematical solution. Given the parameters estimated in the third section, a numerical solution for (3) can be calculated by a digital computer (see the next section). Before turning to the empirical solution, note that the nonautonomous variable t affects sales in a cyclical way as shown in equation (2); however, some important characteristics of the solution can be brought into focus if seasonality is also ignored in part of the analysis:

$$(8)\quad \dot{S} = g(S_t, A_t).$$

In this case the functional relationship between A_t and S_t can be presented by constructing a phase diagram as in Figure 2 where the optimal path towards the steady state is described. An important role in the description of this solution is played by the two singular curves, $\dot{S}=0$ and $\dot{\eta} = 0$. The curve $\dot{S} = 0$ is the geometrical locus of all points in the plane (A, S) where loss of sales due to the decay factor (λ) is exactly balanced by the gain in sales generated by advertising.

From (1) and the regularity conditions the slope of the singular $\dot{S} = 0$ follows:

$$(9)\quad \left.\frac{dA}{dS}\right|_{\dot{S}=0} = -\frac{g_S}{g_A} > 0.$$

This divides the (S, A) plane into two parts with sales increasing over time for coordinates above the curve. From the hypothesis $g_A > 0$, it follows that $\dot{S}$ goes from negative to positive as A increases for a constant value of S. The movements of S are denoted by the small horizontal arrows in Figure 2.

The meaning of the relationship between sales and advertising along the curve $\dot{\eta} = 0$ becomes more evident by substituting (5) into (6) giving

$$(10)\quad \dot{\eta} = (\rho - g_S)\frac{1}{g_A} - 1.$$

Thus along the curve $\dot{\eta} = 0$,

$$(11)\quad \rho - g_S = g_A,$$

$$\text{implying } \begin{Bmatrix}\text{marginal}\\ \text{opportunity}\\ \text{costs of sales}\end{Bmatrix} = \begin{Bmatrix}\text{marginal}\\ \text{productivity}\\ \text{of advertising}\end{Bmatrix},$$

and the slope of this curve is derived from the regularity conditions.

$$(12)\quad \left.\frac{dA}{dS}\right|_{\dot{\eta}=0} = -\frac{g_{SA} + g_{SS}}{g_{AA} + g_{SA}} < 0.$$

Consider a point above the curve $\dot{\eta} = 0$. For a given rate of expenditure A, increasing S implies [by equation (10) and the hypotheses $g_{SS} \leqq 0$ and $g_{AS} < 0$] that $\dot{\eta} > 0$. Since A is an increasing function of η, by (5) and the hypothesis $g_{AA} < 0$, $\dot{\eta} > 0$ implies $\dot{A} > 0$, which explains the direction of the small vertical arrows in Figure 2. Intuitively, for a given level of advertising expenditures, any point to the right of the curve $\dot{\eta} = 0$ represents a higher imputed value

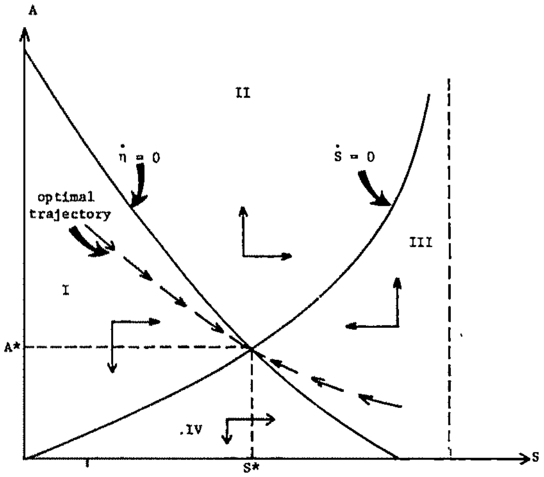

Figure 2. Phase diagram and the optimal control path

of a unit of sales and thus results in an increased level of advertising.

The two curves, $\dot{\eta} = 0$ and $\dot{S} = 0$, divide the $A - S$ plane into four quadrants labeled with roman numerals on the diagram. Using the arguments of Arrow [1] and Arrow and Kurz [2], it can be shown that any path which enters regions II and IV in Figure 2 cannot be an equilibrium path. On the other hand, quadrants I and III contain a unique optimal path that approaches the equilibrium point (S^*, A^*) for the autonomous case.

Let the initial value of sales be $S_0 < S^*$; the behavior of the system is described by that part of the optimal trajectory which lies in quadrant I. A relatively high level of advertising expenditure results in an increase in the level of sales. As the level of sales approaches its equilibrium value S^*, advertising expenditures decrease until they reach equilibrium at A^*. Similarly, for $S_0 > S^*$ the optimal trajectory lies in quadrant III. The initial advertising level is lower than the optimal so that sales decrease over time. However, as sales approach their equilibrium value from above, advertising expenditures increase toward their equilibrium level.

The results of inverse relationship between the level of advertising and the level of sales along the optimal trajectory have been obtained by Gould [6] and Jacquemin [8], assuming convex costs and concave returns, respectively. In this case these results are obtained through the assumption of concave sales response function. The rationale behind "over-shooting" of advertising expenditures for a relatively low level of sales is that the entrepreneur takes into account both the potential number of buyers and the concavity of the response function at the individual consumer level. The first element is incorporated by assuming $g_{AS} < 0$. The second element of diminishing returns to advertising is included by assuming $g_{AA} < 0$. If the initial level of sales is above optimal, the same elements operate but in the opposite direction.

If the sales response function (1) has the specific form as in (2) (with $\beta_2 = 0$), some simple comparative static results can be derived. The effects of changes in the parameters λ, ρ, and M upon the two curves and the stationary values A^* and S^* are summarized in Table 2.

An increase in the interest rate (ρ) results in a decreasing rate of sales and advertising. An increase in the sales decay constant (λ) results in an increase of advertising expenses required to maintain any given level of sales. On the other hand, the stationary level of sales decreases as λ increases. Thus, the direction of change in advertising at the stationary level cannot be predicted.

The contribution of a marginal change in M is measured by its effect on curves $\dot{S} = 0$ and $\dot{\eta} = 0$ in Figure 2. The stationary level (S^*) increases as M increases since

$$\left.\frac{dS}{dM}\right|_{\dot{S}=0} > 0 \quad \text{and} \quad \left.\frac{dA}{dM}\right|_{\dot{\eta}=0} > 0.$$

However, the direction of the change in the stationary advertising level (A^*) cannot be predicted since the magnitude of the shift in $\dot{\eta} = 0$ and $\dot{S} = 0$ curves determine whether A^* increases or decreases. An increase in M increases the marginal contribution of A to S for any given level of sales. Hence, a lower amount of advertising is required. However, the stationary S^* increases, which tends to raise the level of optimal advertising.

Discussion of the Empirical Solution

In the "Econometric Citrus Advertising Model" section, the sales response function (equation 2) to advertising expenditures by the Florida citrus industry was estimated. Using this empirical function and assuming a market interest

Table 2. Changes in the parameters λ, ρ, and M

	Effect of Increase in Parameter Upon:			
Parameter	Curve $\dot{S} = 0$	Curve $\dot{\eta} = 0$	S^*	A^*
ρ	unchanged	shifts downward and to the left	decrease	decrease
λ	shifts upward and to the left	shifts downward and to the left	decrease	unknown
M	shifts downward and to the right	shifts upward and to the right	increase	unknown

rate of 7 percent per year, the optimal advertising policies and the resulting sales paths from given initial levels of sales are calculated first without seasonal effects and then including seasonality.

In the autonomous case the steady state values are $S^* = \$134$ million and $A^* = \$4.1$ million per quarter; the optimal path is described with the phase diagram in Figure 3. The shape of the singular curve $\dot{S} = 0$ implies that when sales are below $100 million, any low level of advertising will increase the sales; however, the optimal solution is to choose higher levels of advertising for those levels of sales which are lower than the steady state and to converge downward to the steady state of advertising as the level of sales increases.

The numerical solution extends beyond the descriptive nature of the phase diagram. Specifically, the time period needed for convergence to a steady state is longer for smaller initial levels of sales. For example, if the initial level of sales were $25 million, the convergence time is 22 quarters while the convergence time reduces to 18 quarters when the initial level of sales is $80 million and 9 quarters when initial sales are $125 million. The numerical solution furnishes additional information about the motion of the system obtained by calculating the functions $-\dot{\eta}/\eta$, $\rho - g_S$, and g_A along the optimal path over the relevant range of sales (Fig. 4). That is, for advertising allocations where $A > A^*$ and $S < S^*$, then marginal productivity of advertising exceeds the marginal opportunity costs of sales. When $A < A^*$ and $S > S^*$, then the reverse holds (i.e., $\dot{\eta}/\eta > 0$).

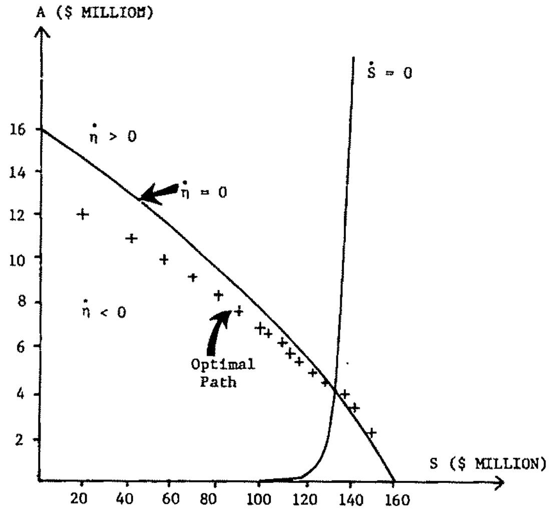

Figure 3. **Phase diagram and optimal control path for citrus advertising**

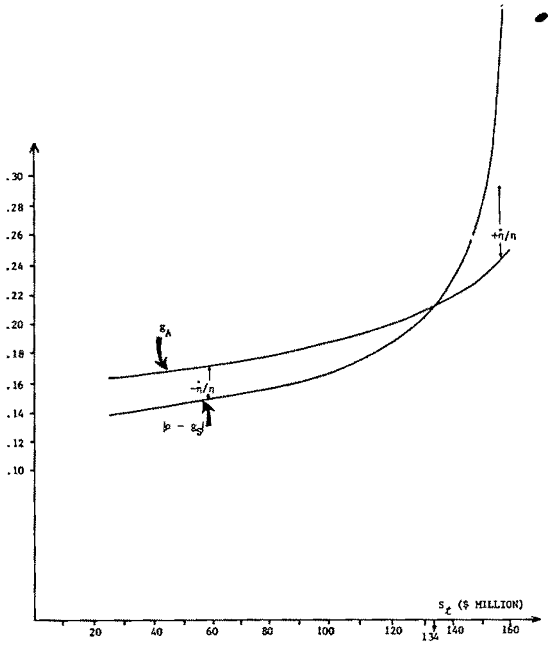

Figure 4. **A comparison of marginal productivity of advertising to marginal opportunity cost of sales**

When the seasonality effect is included by an exogeneous sinusoid function (see equation 2 and Table 1), the system is nonautonomous and the time path of optimal advertising expenditure and optimal level of sales fluctuates accordingly as shown in Figure 5. Note that the seasonal fluctuations are essentially imposed on the autonomous optimal path. Assuming an initial level of $25 million sales, then the same level of advertising expenditures as in the autonomous cases follows S, and the optimal path for A decreases as the level of sales increases at about the same rate as in both cases. After 22 quarters, sales and advertising reach steady amplitudes which average around $134 and $4.1 million, respectively. These are exactly the steady state values in the autonomous case. Further note that the peaks of the advertising amplitudes correspond exactly to the troughs in the sales path. The values g_A, $\rho - g_S$, $\dot{\eta}/\eta$ along a complete seasonal cycle are given in Table 3.

Policy Comparisons and Implications

Policy implications of the optimal control solution which is normative in its nature may be best evaluated in comparison to the Dorfman-Steiner theorem which states that the maximizing

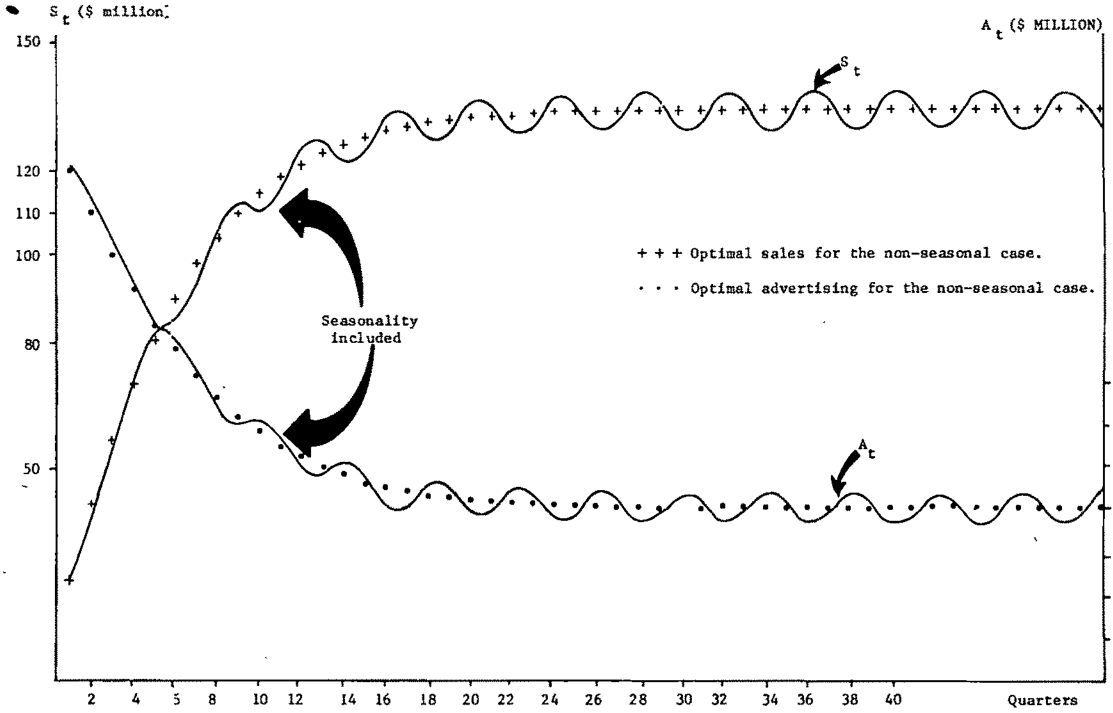

Figure 5. Optimal control solution with and without the seasonality adjustment

profit firm should equate its marginal sales response to advertising with the price elasticity of demand [4, p. 826]. Retail demand estimates for citrus indicate a unitary price elasticity; hence, the optimal level of advertising expenditure for any given level of sales according to Dorfman and Steiner's criterion can be solved from the expression $g_A = 1$. A level of sales of $80 million results in $1.5 million of advertising expenditure, while $134 million will result in advertising expenditures of about $1 million. Even though the negative relationship of advertising to sales appears here too, clearly the advertising level is considerably lower than the optimal control policy. This is a result of the fact that the profit-making firm or industry adopting Dorfman and Steiner's criterion fails to take into account the imputed price of sales (η) which is the implicit future benefits resulting from a unit increase of advertising at time *t*.

Table 3. Values g_A, $\rho - g_S$, $\dot{\eta}/\eta$ along a complete seasonal cycle

t (*Season*)	*S*	*A*	$\rho - g_S$	g_A	$\dot{\eta}/\eta$
	--- $ million	---			
.					
.					
.					
56 (Winter)	138.02	3.776	.219	.210	+.0093
57 (Spring)	137.12	3.882	.217	.208	+.0090
58 (Summer)	130.11	4.404	.200	.210	−.0095
59 (Fall)	130.93	4.302	.202	.212	−.0100
.					
.					
.					

The actual policy of the Florida citrus industry in the years 1967–72 was shown in Figure 1. While the average annual advertising expenditure is relatively stable around $10 million, the annual sales level showed substantial increases over the marketing seasons since 1967. Planning of advertising expenditures is completed each year in part according to the supply projections for the coming year. Advertising reserve funds do exist, however, to prevent exceptional variations in the general programs when realized supplies fall considerably below early projections.

A comparison of the optimal control model to these actual advertising expenditures provides a learning tool for the industry in that it can show what could have been realized during the periods under study. Through a simple updating of the data used in the econometric model and increases in the market potential (*M*), the same model can be used to provide guidelines for the immediate planning periods.

A comparison of the optimal control solution

Table 4. A comparison of actual citrus industry advertising expenditures and resulting sales to that of an optimal control solution

	Actual		Optimal		Present Value	
Year	Sales	Advertising	Sales[a]	Advertising	Net Actual[a] (S — A)	Net Optimal[a] (S — A)
			— — — $ million — — —			
1968	$ 392	$10.4	$ 398	$28.2	$ 381.6	$ 369.8
1969	426	10.1	476	21.9	388.7	424.4
1970	456	10.6	512	18.7	389.0	430.9
1971	514	11.3	527	17.3	383.5	338.8
TOTAL	$1,788	$42.4	$1,913	$86.1	$1,542.8	$1,613.9
			NET GAIN (Actual)	= $81.3		
			NET GAIN (Present Value)	= $71.1		

[a] Present value is calculated at 7 percent annually.

shown in Figure 5 and the actual advertising and sales initially shown in Figure 1 is compared on an annual basis in Table 4. Table 4 shows the accumulated advertising and sales over the periods analyzed. First, assuming a target sales variable or steady state value of $536 million annually (i.e., $134 million per quarter), then a comparison of the net gains from the optimal allocation over the period considered becomes immediately evident.

The gains realized from the optimal policy include both the annual reallocations of the budget and reallocations among quarters. Actual policies show the seasonality of both sales and advertising to be in phase; however, the optimal policy would suggest that some redistribution of advertising funds from the winter quarters to the summer would be desirable. The model provides clear signals as to changes that could have been made to increase the effectiveness of advertising expenditures. Likewise, the methodology for updating the model and the model's application as a tool to provide signals to the citrus industry for planning advertising strategies become evident.

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Price Expectations and the Welfare Gains from Price Stabilization

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The gains from price stabilization are analyzed in the case where supply decisions are made before the actual market price is known and so are based on price expectations. Two expectations generating mechanisms are considered—the "adaptive" scheme and the "rational" hypothesis. In both cases price stabilization provides an overall welfare gain that is higher than when supply depends upon actual prices. The distribution of these gains among producers and consumers is shown to depend crucially upon how the expectations are generated, as well as the source and autoregressive properties of the random price fluctuations.

Key words: **price fluctuations; price expectations; stabilization; welfare gains.**

THE DESIRABILITY of price stabilization has long been debated among economists. Much of the discussion has taken place in the context of agricultural commodities where random fluctuations in both demand and supply can be particularly important. In broad terms one can trace out two parallel sets of analyses. On the one hand, originating with Waugh [14] is the proposition that consumers having a downward sloping demand curve and facing random prices due to stochastic fluctuations in supply are better off than if these prices were stabilized at their means.[1] Using a similar argument, some years later Oi [6] demonstrated that firms having a given upward sloping supply curve and facing random selling prices arising from stochastic shifts in demand will also lose from having these prices stabilized at their means.[2]

These two approaches considered the welfare of one group only, ignoring the effects the price stabilization scheme may have on the other. As a consequence, more recently Massell [2] has integrated these two analyses within the framework of a linear model, obtaining a number of interesting results. First, he showed that whether price stabilization benefits one group or the other depends upon the source of the random price fluctuations. For example, while his model confirms the Oi result, he also shows that if the random price is due to fluctuations in supply, then producers will in fact benefit from price stabilization. Second, when both producers and consumers are taken into account simultaneously, price stabilization will always improve total welfare, even though one group may be adversely affected. Hence overall, price stabilization is to be preferred.

A key aspect of the Waugh-Oi-Massell analyses is the assumption that demand and supply depend upon actual prices. This means that both consumers and producers base their decisions on complete information, although this information is constantly changing. Consequently, this literature can be described more appropriately as applying to a situation of price variability, rather than price uncertainty, since an important aspect of this latter case is the fact that some decisions must be made on the basis of imperfect information.

Since consumers typically need not make their decisions until they are confronted with actual prices, this assumption is perfectly natural as far as the demand side is concerned and especially so with agricultural products. For firms, however, the assumption is much less realistic. Indeed it runs counter to virtually all recent work on the theory of the firm under uncertainty, which emphasizes the need to make some, if not all, production (supply) decisions before the actual selling price is known. In this context, the assumption can be justified by supposing either that firms have perfectly flexible production plans —that is, they are able to modify their original decisions at zero cost when they learn the actual selling price—or by granting them perfect foresight. Clearly either of these assumptions is most restrictive in a stochastic environment.[3] This is

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[1] Waugh's original contribution in 1944 generated considerable discussion at that time. For more recent discussions see Waugh [13], and Wegge, Sosnick, and George [15].

[2] This proposition also generated a vigorous debate; see, for example, Tisdell [10] and Zucker [16].

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[3] Building on many previous contributions, Leland [1] and Sandmo [9] develop quite general models in which firms are required to make *all* their production decisions before the actual selling price is known, on the basis of their price expectations. One can refer to this as the case of "total inflexibility," and as such it represents the other extreme to that considered by Oi. Elsewhere [11] the intermediate case, where firms possess some flexibility, has been analyzed. In that paper, firms are assumed to make their initial production decisions on the

particularly so with agricultural commodities, where production lags may be important and firms lack this ability to make instantaneous adjustments.

The purpose of this paper is to consider the welfare effects for both producers and consumers of introducing price stabilization, in the case where firms make their supply decisions on the basis of expected prices before they learn the actual market price and are unable to modify these decisions in the short run. This is precisely the underlying assumption of all the "cobweb" type analyses which developed from this aspect of agricultural commodity markets.[4] In his 1963 exchange with Oi [7], Tisdell [10] briefly discussed this case for producers and argued that under this assumption they will benefit from price stability. However, he did not pursue the question in detail, and as the analysis here shows, the answer to this question (and others) is by no means unambiguous.

Following Waugh, Oi, and Massell, the welfare gains to producers in this paper are evaluated in terms of expected producers' surplus (expected profit); likewise consumers' welfare gains are measured by expected consumers' surplus. The limitations of these welfare measures are well known and must be borne in mind in considering the results. Two alternative kinds of processes according to which producers are assumed to generate their expectations are considered. The first is the case where they are formed "adaptively." This is undoubtedly the most widely used of the autoregressive forecasting procedures, which as a group are recognized as being rather restrictive and usually non-optimal, since they do not allow the forecaster to use all available information in forming his prediction. Accordingly, as an alternative approach it is assumed that producers form their expectations "rationally" in the sense of Muth [4]. That is, producers are assumed to make forecasts consistent with those of the model and to use all available information efficiently. As will become clear from the analysis below, some of the welfare effects of price stabilization, and particularly the validity of the Oi proposition, depend upon the forecasting procedure used to generate the expectations. Moreover, once supply is made to depend upon expected price, the autoregressive properties of the stochastic disturbances—which play virtually no role in Massell's analysis—become crucially important.

The remainder of the paper, which uses linear models throughout, proceeds as follows. For convenience and to provide a comparison with later results, it begins with a brief summary of the Waugh-Oi-Massell analysis. For reasons already given this shall periodically be referred to as the "perfect flexibility" model. The third section considers the case of adaptive expectations, while the fourth deals with the rational expectations case. The main conclusions are summarized in the last section.

The Waugh-Oi-Massell Model

Consider a single market in which demand and supply are described by the linear relations

$$(1.1)\quad D(P_t) = A - aP_t + u_t \qquad a \geqq 0$$

$$(1.2)\quad S(P_t) = B + bP_t + v_t \qquad b \geqq 0$$

where D_t = demand, S_t = supply, P_t = current price, and A, B, a, b, are deterministic constants. The terms u_t, v_t denote additive stochastic disturbances, which are assumed to be generated by the first-order autoregressive processes

$$(2.1)\quad u_t = \rho_1 u_{t-1} + e_{1t} \qquad -1 < \rho_1 < 1$$

$$(2.2)\quad v_t = \rho_2 v_{t-1} + e_{2t} \qquad -1 < \rho_2 < 1.$$

The variables e_{1t}, e_{2t} have zero means, variances $\sigma_{e_1}^2$, $\sigma_{e_2}^2$ with zero covariance. This last assumption means that the random shifts in the demand and supply schedules are independent of one another. Equations (2.1) and (2.2) immediately imply

$$(3.1)\quad E(u_t) = E(v_t) = 0$$

$$(3.2)\quad \begin{cases} E(u_t^2) = \sigma_u^2 = \sigma_{e_1}^2/(1-\rho_1^2), \\ E(v_t^2) = \sigma_v^2 = \sigma_{e_2}^2/(1-\rho_2^2) \end{cases}$$

$$(3.3)\quad E(u_t v_t) = 0.$$

In the absence of price stabilization, the short-run equilibrium price P_t will be

$$(4.1)\quad P_t = (u_t - v_t + A - B)/(a+b)$$

while the equilibrium quantity traded will be

$$(4.2)\quad D(P_t) = S(P_t) = \frac{Ba + bA}{a+b} + \frac{av_t + bu_t}{a+b}.$$

Suppose now that a stabilization authority es-

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basis of expected prices, but are able to modify these decisions at some finite cost after they learn the true selling price.

[4] See for example Muth [4], Nerlove [5], Pashigian [8], and Turnovsky [12].

tablishes a buffer stock, being willing to buy or sell the commodity at a price P_s, at which the non-stochastic components of demand and supply are equal. That is, it sets P_s where

$$(5)\qquad E(D_t) = E(S_t)$$

so that on the average the market balances. To maintain this price, the authority must continually trade an amount

$$x_t = v_t - u_t,$$

the expected value of which is zero.[5] Hence the buffer stock will be self-liquidating in the sense that the expected size of the buffer stock will remain constant over time. Taking expected values of (1) yields[6]

$$(6)\qquad P_s = (A - B)/(a + b) = E(P_t)$$

with the corresponding quantities

$$(7.1)\qquad D(P_s) = \frac{Ba + bA}{a + b} + u_t$$

$$(7.2)\qquad S(P_s) = \frac{Ba + bA}{a + b} + v_t$$

Measuring producers' welfare by producers' surplus (profit), their welfare in the absence of price stabilization, when the random price P_t prevails, is

$$\pi_t = \int_{P(0)}^{P_t} S(P')dP'$$

where $P(0)$ denotes the supply price at zero output. Likewise, profit at the stabilized price P_s is given by

$$\pi_s = \int_{P(0)}^{P_s} S(P')dP'$$

so that the difference in producers' welfare in the two cases is simply

$$(8)\qquad G_p = \pi_s - \pi_t = \int_{P_t}^{P_s} S(P')dP'.$$

Substituting the linear supply function (1.2), (8) integrates to

$$(9)\qquad G_p = \frac{1}{2}[P_s - P_t][S(P_t) + S(P_s)]$$

$$= -\frac{1}{2}\left(\frac{u_t - v_t}{a + b}\right)\left(\frac{2[Ba + bA]}{a + b} + \frac{[2a + b]v_t + bu_t}{a + b}\right).$$

Similarly, measuring consumers' welfare by consumers' surplus, their difference in welfare becomes

$$(10)\quad G_c = \frac{1}{2}[P_t - P_s][D(P_t) + D(P_s)].$$

Furthermore, assuming that total welfare can be adequately measured by the sum of producers' and consumers' surplus,

(11)

$$G = G_p + G_c = \frac{1}{2}[P_s - P_t][S(P_s) - D(P_s)].$$

The expected gains from stabilization (which are usually referred to as just "gains") to producers, consumers, and the two groups together are obtained by taking expected values of (9), (10), (11), respectively, yielding

$$(12.1)\quad E(G_p) = \frac{-b\sigma_u^2 + (2a + b)\sigma_v^2}{2(a + b)^2}$$

$$(12.2)\quad E(G_c) = \frac{(2b + a)\sigma_u^2 - a\sigma_v^2}{2(a + b)^2}$$

$$(12.3)\quad E(G) = \frac{(\sigma_u^2 + \sigma_v^2)}{2(a + b)} > 0$$

Equations (12.1)–(12.3) immediately yield most of Massell's principal conclusions:

(i) Producers lose (gain) from price stabilization if the source of price instability is random shifts in demand (supply);

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[5] It is also important to note that the net revenue of the stabilizing authorities is $(u_t - v_t)P_s$, the expected value of which is zero, implying that they can expect to break even.

It should also be pointed out that the present analysis assumes the authorities to stabilize completely for both kinds of disturbances. More generally, one could imagine a partial stabilization scheme described by

$$x_t = \alpha v_t - \beta u_t \qquad 0 < \alpha \leqq 1, \qquad 0 < \beta \leqq 1.$$

Given the linearity of the model and the welfare measures, this generalization does not alter the results in any substantial way. In particular, the signs of the gains from stabilizing for either of the random disturbances separately, upon which most of the subsequent analysis focuses (i.e., the terms G_{ij}, G_j defined below), are independent of α, β.

However, one interesting difference with incomplete stabilization is that, despite the fact that the buffer stock will be self-liquidating, the stabilizing authorities will in general make a profit. In the present model it can be easily shown that for $0 < \alpha < 1$, $0 < \beta < 1$, their expected net revenue will be positive.

[6] Observe that in this case the self-liquidating buffer stock implies that price is stabilized at its mean. This result is a consequence of the linearity of the model.

(ii) consumers lose (gain) from price stabilization if the source of price instability is random shifts in supply (demand);

(iii) where both demand and supply are random, the gains to each group are indeterminate and depend upon the relative sizes of the variances σ_u^2, σ_v^2, and upon the slopes of the demand and supply curves;

(iv) the total gains from stabilization are always positive, with the gainers in principle being able to compensate the losers.

Note also that the gains or losses are strictly proportional to the variances σ_u^2, σ_v^2. Furthermore, the autoregressive structure of u_t, v_t affects the gains only through these variances, so that as the autoregressive coefficients $\rho_i \to \pm 1$, the gains or losses tend to infinity. If the demand or supply curve becomes infinitely elastic, the gains from stabilization tend to zero. Finally, these results all depend crucially on the linearity of the model and the additivity of the stochastic disturbances. One can show that with non-linear demand and supply functions, some of these propositions cease to hold.

Adaptive Expectations

Suppose now that firms make their supply decisions on the basis of anticipated prices. That is, (1.2) is replaced by the equation

$$(1.2') \quad S(P^*_t) = B + bP^*_t + v_t \qquad b \geqq 0$$

where P^*_t denotes the selling price producers expect to prevail at period t.[7] The assumption that these expectations are formed adaptively is described by the equation

$$(13) \quad P^*_t - P^*_{t-1} = \gamma(P_{t-1} - P^*_{t-1}) \qquad 0 \leqq \gamma \leqq 1.$$

This equation asserts that the change in expectations equals some fraction of the previous period's forecast error, where γ describes the rate of adaptation.

Consumers are still assumed to make their decisions on the basis of actual market prices, so that demand is still described by (1.1). Moreover, the stochastic disturbances are still assumed to be generated by (2) and (3). Equating (1.1) and (1.2′), lagging both sides and multiplying by $(1 - \gamma)$, and finally subtracting the result from the initial equation enables one with the aid of (13) to eliminate P^*_t. Thus, the market clearing price P_t in the absence of price stabilization is given by

$$(14) \quad P_t = \frac{(A-B)\gamma}{a} + \left(\frac{-b\gamma}{a} + 1 - \gamma\right)P_{t-1} + \frac{[u_t - (1-\gamma)u_{t-1}] - [v_t - (1-\gamma)v_{t-1}]}{a}$$

where to ensure that the variance of P_t remains finite,[8]

$$(15) \quad -1 < \frac{-b\gamma}{a} + 1 - \gamma < 1.$$

Letting

$$(16.1) \quad z_t = \frac{[u_t - (1-\gamma)u_{t-1}]}{a} - \frac{[v_t - (1-\gamma)v_{t-1}]}{a}$$

$$(16.2) \quad \lambda = \frac{-b\gamma}{a} + 1 - \gamma,$$

(14) can be written in the form[9]

$$(17) \quad P_t = (A-B)/(a+b) + \sum_{i=0}^{\infty} \lambda^i z_{t-i}$$

with the corresponding equilibrium quantities

$$(18) \quad D(P_t) = S(P^*_t) = \frac{Ba + bA}{a+b} - a\sum_{i=0}^{\infty} \lambda^i z_{t-i} + u_t.$$

Consider now the introduction of price stabilization. If prices are continually stabilized at a level P_s, then $P_t = P_s$ for all t, so that clearly $P^*_t = P_s$. Moreover, if as before, P_s is chosen so as to make the buffer stock self-liquidating, P_s, $D(P_s)$, and $S(P_s)$ will again be determined by

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[7] This case is the other extreme of no short-run flexibility in production. The intermediate model described in footnote 3 yields a supply function of the form

$$S_t = B + bP^*_t + cP_t + v_t \qquad b \geqq 0, \qquad c \geqq 0,$$

and this can be readily analyzed along the lines of this paper.

[8] This is a very weak form of stochastic stability; for an analysis of a more stringent form in the context of such "cobweb" models, see [12].

[9] Equation (17) is obtained by successive substitutions of P_{t-1} in (14). Strictly speaking it is an asymptotic expression in that the initial point is assumed to be infinite periods in the past.

(6), (7.1), and (7.2) respectively. Furthermore, the expressions for the various gains are still given by (9), (10), and (11), the only difference being that P_t, $D(P_t)$, $S(P^*_t)$ are now given by the expressions in (17) and (18).

The welfare of producers is

$$(19)\quad G_p = -\frac{1}{2}\left[\sum_{i=0}^{\infty}\lambda^i z_{t-i}\right]\left[(u_t+v_t) + 2\left(\frac{aB+bA}{a+b}\right) - a\sum_{i=0}^{\infty}\lambda^i z_{t-i}\right]$$

so that[10]

$$(20)\quad E(G_p) = -\frac{1}{2}E\left[(u_t+v_t)\sum_{i=0}^{\infty}\lambda^i z_{t-i} - a\left(\sum_{i=0}^{\infty}\lambda^i z_{t-i}\right)^2\right]$$

where it should be recalled that z_t and λ are defined in (16), while u_t, v_t satisfy the autoregressive equations (2). Expanding the infinite sums in (20) and taking expected values yields, with some manipulation, the following expression for $E(G_p)$:

$$(21.1)\quad E(G_p) = G_{11}\sigma_u{}^2 + G_{12}\sigma_v{}^2$$

where

$$G_{11} = \left\{\frac{(1-\lambda-\gamma)[(1-\gamma)(1+\lambda\rho_1)}{2a(1-\lambda^2)(1-\lambda\rho_1)} - \frac{(\rho_1+\lambda)]}{2a(1-\lambda^2)(1-\lambda\rho_1)}\right\}$$

$$G_{12} = \left\{\frac{[1-(1-\gamma)\rho_2][(2+\lambda)}{2a(1-\lambda^2)(1-\lambda\rho_2)} \quad \frac{(1-\lambda)+\lambda\gamma]}{2a(1-\lambda^2)(1-\lambda\rho_2)} + \frac{(1-\lambda-\gamma)(1-\gamma-\rho_2)}{2a(1-\lambda^2)(1-\lambda\rho_2)}\right\}$$

and $\sigma_u{}^2$, $\sigma_v{}^2$ are given in (3).

Similarly, substituting (6), (7), (17), and (18) into (10) implies the following expression for consumers' welfare:

$$G_c = \frac{1}{2}\left[\sum_{i=0}^{\infty}\lambda^i z_{t-i}\right]\left[\frac{2(aB+bA)}{a+b} - a\sum_{i=0}^{\infty}\lambda^i z_{t-i} + 2u_t\right],$$

the expected value of which is

$$(21.2)\quad E(G_c) = G_{21}\sigma_u{}^2 + G_{22}\sigma_v{}^2$$

where

$$G_{21} = -\left\{\frac{(1+\lambda\rho_1)(1-\gamma-\lambda)^2}{2a(1-\lambda^2)(1-\lambda\rho_1)} + \frac{(1-\lambda\rho_1)(\lambda^2-1)}{2a(1-\lambda^2)(1-\lambda\rho_1)}\right\}$$

$$G_{22} = -\left\{\frac{2(1-\gamma)(1-\lambda)(1-\rho_2)}{2a(1-\lambda^2)(1-\lambda\rho_2)} + \frac{\gamma^2(1+\lambda\rho_2)}{2a(1-\lambda^2)(1-\lambda\rho_2)}\right\}.$$

Adding (21.1) and (21.2), total expected gains are given by

$$(21.3)\quad E(G) = E(G_p) + E(G_c) = G_1\sigma_u{}^2 + G_2\sigma_v{}^2$$

where

$$G_1 = \frac{[\;-\rho_1(1-\gamma)]}{2a(1-\lambda\rho_1)} > 0$$

$$G_2 = \frac{[\;-\rho_2(1-\gamma)]}{2a(1-\lambda\rho_2)} > 0.$$

The three equations in (21) summarize the welfare gains from price stabilization. The expressions for $E(G_p)$ and $E(G_c)$ are extremely complex, although many of the terms cancel out in the expression for $E(G)$. In general these expressions depend upon a, b, γ, ρ_1, and ρ_2, as well as the variances $\sigma_u{}^2$, $\sigma_v{}^2$, in extremely complicated and interacting ways. Nevertheless, several interesting conclusions emerge.

The term $G_{11}\sigma_u{}^2$ describes the gains (or losses) to producers from having demand fluctuations stabilized. It is the expression upon which Oi focused and which under his assumption was shown to be negative. However, this need not be so in the present model. From (16.2) $1-\lambda-\gamma \geqq 0$, implying

$$(22)\quad \operatorname{sgn} G_{11} = \operatorname{sgn}[(1-\gamma)(1+\lambda\rho_1) - (\rho_1+\lambda)]$$

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[10] Note that in going from (19) to (20), all terms involving $(aB+bA)/(a+b)$ vanish due to the fact that they always appear multiplicatively with some z_{t-i}, the expected value of which is zero.

which can be of either sign. That is, producers experiencing price uncertainty due to random fluctuations in demand can either gain or lose from price stability. The likelihood of having gains varies inversely with the autoregressive parameter ρ_1. If the u_t are negatively autocorrelated or independently distributed so that $\rho_1 \leqq 0$, one can show that $G_{11} > 0$, implying a gain for producers. However, they may be worse off with stabilization if the u_t are strongly positively autocorrelated. Consider, for example, $\gamma = 1$, so that the adaptive mechanism degenerates to static expectations, namely $P^*_t = P_{t-1}$. In this case,

$$G_{11} < 0 \text{ for } 1 > \rho_1 > -b/a$$

which is perfectly consistent with (15) and could quite conceivably arise. Moreover, as $\rho_1 \rightarrow 1$, $G_{11} < 0$ unambiguously.

Thus whether or not producers facing an uncertain demand will gain or lose from having prices stabilized depends crucially on the autoregressive properties of the random disturbance, as well as on the length of lag in the formation of expectations and the relative slopes of the demand and supply schedules. Nothing conclusive can be inferred until these parameters are specified.

The coefficient G_{12} is positive for all feasible parameter values, implying that positive gains to producers will result from stabilizing supply fluctuations. This result, which was also obtained in the perfect flexibility case of the second section, is not immediately obvious from (21.1). It can be established by first showing that $\partial G_{12}/\partial \rho_2 < 0$ and then observing that $G_{12} > 0$ for $\rho_2 = 1$.

Turning to consumers, the coefficient $G_{22} < 0$, implying the Waugh proposition that consumers are hurt by having prices stabilized in the face of supply fluctuations. That this result continues to apply is not really surprising, since in the present model consumers are still able to make their decisions on the basis of actual market prices, so that in this respect the consumer side of the analysis is essentially unchanged.

On the other hand, G_{21} is the most indeterminate in sign, implying that consumers could either gain or lose from having their own demand fluctuations stabilized. Just how indeterminate this impact is, can be seen by taking the simple example of static expectations and independently distributed disturbances ($\gamma = 1$, $\rho_1 = 0$), in which case

$$G_{21} \doteq 2\lambda^2 - 1 = (2b^2/a^2 - 1) \leqq 0,$$

depending upon the relative slopes of the demand and supply curves.

Despite the fact that the demand side of the market is essentially unchanged from the analysis of the second section, this result differs quite markedly from the corresponding response of the earlier model. The reason for the difference stems from the fact that under the adaptive expectations hypothesis, supply becomes a function of previous prices. With demand being subject to stochastic shifts, these prices become random, so that in the absence of price stabilization, the random elements in demand induce random shifts in supply. Thus in effect, this case creates simultaneous stochastic disturbances in demand and supply. As shown in the second section, stabilizing for these two sources of random disturbances has offsetting effects on consumer welfare, thereby creating the resulting indeterminancy.

The above comments can be summarized as follows. As in the Massell model, stabilizing for supply fluctuations will improve the welfare of producers and deteriorate that of consumers. On the other hand, stabilizing for demand fluctuations can have very different welfare effects from those implied by the previous model. However, again as in the previous model, total welfare, as measured by the sum of producers' and consumers' welfare is increased with stabilization, even though one group may be hurt.

It is of interest to consider how the various welfare gains discussed above respond to changes in the parameters of the model, and to do this involves differentiating these expressions with respect to different parameters. Unfortunately, due to the complexity of the expressions for the G_{ij}, doing these exercises for producers and consumers separately turns out to be excessively cumbersome and not very illuminating. Consequently, this more detailed analysis is restricted to total welfare $E(G)$, which is considered more fully below. Here the discussion of the sensitivity of producers' and consumers' welfare is restricted to looking at a few limiting cases.

First, if $a \rightarrow \infty$, that is, demand is infinitely elastic, all gains tend to zero as before. Likewise, all gains converge to those of the previous model if $b \rightarrow 0$.[11] Second, letting $\gamma \rightarrow 0$, so that the expectation is infinitely slow to adjust, $G_{11} \rightarrow 0$, implying that all gains from stabilizing for demand go to consumers (i.e., $G_{21} = G_1 \rightarrow \sigma_u^2/2a$). On the other hand, $G_{12} \rightarrow \sigma_v^2/a$, $G_{22} \rightarrow -\sigma_v^2/2a$, $G_2 \rightarrow \sigma_v^2/2a$, making the producers' gain from supply stabilization equal twice the consumers' loss.

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[11] The other limiting cases $a \rightarrow 0$, $b \rightarrow \infty$, are not considered as these violate the stability requirement (15).

Third, as the autoregressive coefficients tend to unity, i.e., $\rho_i \rightarrow +1$, the G_{ij} are all finite ($G_{11} < 0$, $G_{12} > 0$, $G_{21} > 0$, $G_{22} < 0$) while the variances σ_u^2, $\sigma_v^2 \rightarrow \infty$, making all the corresponding gains or losses infinite. Similarly, if $\rho_i \rightarrow -1$, then $G_{11} > 0$, $G_{12} > 0$, $G_{21} \gtreqless 0$, $G_{22} < 0$, again implying infinite impacts. One difference worth noting is that, while with positively autocorrelated disturbances producers suffer an infinite loss by having demand fluctuations stabilized, they now make an infinite gain.

Consider now the expression for total expected welfare gains $E(G)$, which from (21.3) are seen to be unambiguously positive (or at least nonnegative). A first question of some interest is to compare the magnitude of these gains with those obtained for the Waugh-Oi-Massell model where perfect production flexibility was assumed. Letting $E(G)_{\mathrm{I}}$, $E(G)_{\mathrm{II}}$ denote the terms in (12.3) and (21.3) respectively:

$$(23)\quad E(G)_{\mathrm{II}} - E(G)_{\mathrm{I}} = \frac{b}{2(a+b)a}\left[\frac{1-\rho_1}{1-\lambda\rho_1}\sigma_u^2 + \frac{1-\rho_2}{1-\lambda\rho_2}\sigma_v^2\right] \gtreqless 0.$$

Hence, the total expected gains from introducing price stabilization when supply decisions are based upon adaptively formed expected prices are at least as great as those obtained when supply depends upon actual prices. This result is in accordance with intuition; the less the information upon which decisions are based, the larger one would expect the gains from stabilization to be. The instances in which the gains under adaptive expectations reduce to those of the perfect flexibility supply model are the limiting ones where $b \rightarrow 0$, $a \rightarrow \infty$, $\rho_i \rightarrow 1$.

Differentiating (21.3) with respect to a, b, the gains are found to vary inversely with the slope of the demand curve, while their relationship to the slope of the supply curve depends crucially on the ρ_i. If both $\rho_i > 0$ (< 0), the gains vary inversely (directly) with b; if both ρ_i are zero, they are independent of the slope of the supply curve; if they are of opposite sign, the relationship could go either way.

The other parameters of interest are ρ_i, γ. While it is clear that $E(G) \rightarrow \infty$, as $\rho_i \rightarrow \pm 1$, the gains are not monotonic in $|\rho_i|$, as is evident from the following expression:

$$(24)\quad \frac{\partial E(G)}{\partial \rho_i} = \frac{\sigma_i^2}{2a}\left[\frac{(\lambda+\gamma-1)(1-\rho_i^2)}{(1-\lambda\rho_i)^2(1-\rho_i^2)} + \frac{2\rho_i[1-\rho_1(1-\gamma)]}{(1-\lambda\rho_i)^2(1-\rho_i^2)}\right]$$

where $\sigma_i^2 = \sigma_u^2$, σ_v^2 respectively for $i = 1, 2$.

Taking $\rho_i = 0$ yields $\frac{\partial E(G)}{\partial \rho_i} < 0$, while for $\rho_i = 1$, $\frac{\partial E(G)}{\partial \rho_i} > 0$. That is, gains from stability are a decreasing function of ρ_i for values of ρ_i near zero, but an increasing function for high values. The reason is that ρ_i affects $E(G)$ in two offsetting ways. On the one hand an increase in ρ_i increases the variance σ_i^2, making stabilization more desirable; on the other hand the coefficients G_i are decreasing functions of the ρ_i, which reduces the gain per unit of variance.

Finally, differentiating $E(G)$ with respect to γ, the rate of adaptation,

$$(25)\quad \frac{\partial E(G)}{\partial \gamma} = \frac{(\gamma+\lambda-1)}{2a}\left[\frac{\rho_1(1-\rho_1)\sigma_u^2}{1-\lambda\rho_1} + \frac{\rho_2(1-\rho_2)\sigma_v^2}{1-\lambda\rho_2}\right].$$

Note that for $\rho_i = 0$ or $\rho_i = 1$, $i = 1, 2$, gains are independent of γ. However, in all other cases the effect will depend crucially on the signs of the autoregressive parameters. For example, if both demand disturbances and supply disturbances are positively autocorrelated, a decrease in the rate at which expectations are adjusted (i.e., a decrease in γ) will tend to increase the desirability of price stability; the opposite conclusion follows, however, for $\rho_i < 0$.

Rational Expectations

Despite its widespread use in a variety of contexts, the adaptive expectations hypothesis has periodically come under severe criticism, especially when applied to predicting *endogenous* variables These objections have been along the following lines. By forecasting an endogenous variable on the basis of past values of that variable alone, one is clearly disregarding a considerable volume of available information relevant to that variable. In particular one is ignoring any knowledge one might have of the economic structure being analyzed and which by definition will determine the endogenous variable. Indeed there is no reason to suppose that the predictions generated from the adaptive expectations scheme will be consistent with those implied by the model. Hence it has been argued that if forecasters are aware of the structure of the relevant economic system, the rational way for them to form their expectations is to base them on the predictions of the model.

This hypothesis which originated with Muth [4] is formally described by

$$(26)\qquad P^*_t = E_{t-1}(P_t)$$

where E_{t-1} denotes conditional expectation at time $(t-1)$. This equation asserts that the forecaster's predicted price for period t should equal the price predicted by the system, conditional on all the information available at time $(t-1)$ when the forecast is made. Thus the prediction, along with the actual realization, becomes an *endogenous* part of the model. Predicting according to (26) can easily be shown to minimize the variance of the forecast error and to be most efficient in that sense.

On the other hand, the assumption of rational expectations does require forecasters to have complete knowledge of the economic structure within which they are predicting (apart from random errors), and one might legitimately question the validity of this assumption. This criticism would seem to be most relevant to some of the recent attempts to apply rational expectations within the context of complete macro models, since most forecasters will be acquainted with only part of the system. The assumption seems less objectionable in the case of a single market, where it is more reasonable to suppose that producers have the required amount of information.

With the rationality assumption and no price stabilization, the model becomes identical to equations (1.1), (1.2′), (26), (2.1), and (2.2). The market clearing price P_t is given by the equation

$$(27)\qquad A - aP_t + u_t = B + b\,E_{t-1}(P_t) + v_t.$$

Taking conditional expectations at time $(t-1)$ of this equation,

$$A - a\,E_{t-1}(P_t) + \rho_1 u_{t-1} = B + b\,E_{t-1}(P_t) + \rho_2 v_{t-1},$$

from which it follows that the rational (endogenous) price expectations are

$$(28)\qquad P^*_t = E_{t-1}(P_t) = \frac{A-B}{a+b} + \frac{\rho_1 u_{t-1} - \rho_2 v_{t-1}}{a+b}.$$

Substituting for $E_{t-1}(P_t)$ in (27), the equilibrium price is given by the equation

$$(29)\qquad P_t = \frac{A-B}{a+b} + \frac{b}{a(a+b)}[\rho_2 v_{t-1} - \rho_1 u_{t-1}] + \frac{u_t - v_t}{a},$$

and substituting for P_t into (1.1) yields

$$(30)\qquad D(P_t) = S(P^*_t) = \frac{Ba+bA}{a+b} - \frac{b}{a+b}[\rho_2 v_{t-1} - \rho_1 u_{t-1}] + v_t.$$

With prices stabilized at P_s, $P_t = P_s$, implying $P^*_t = E_{t-1}(P_t) = P_s$, so that with a self-liquidating buffer stock P_s, $D(P_s)$ and $S(P_s)$ will again be given by (6), (7.1), and (7.2), respectively. Substituting the relevant terms into various expressions for the welfare gains, (9), (10), and (11), yields for example,

$$G_p = \frac{1}{2}\left[\frac{v_t - u_t}{a} + \frac{b}{a(a+b)}[\rho_1 u_{t-1} - \rho_2 v_{t-1}]\right]\left[\frac{2(Ba+bA)}{a+b} + 2v_t + \frac{b}{a+b}(\rho_1 u_{t-1} - \rho_2 v_{t-1})\right]$$

with corresponding expressions for G_c and G.

Taking expected values, the following expressions for the expected welfare gains are obtained:

$$(31.1)\qquad E(G_p) = \frac{1}{2a}\left[\frac{-ab\rho_1^2}{(a+b)^2}\sigma_u^2 + \left(2 - \frac{b(3a+2b)\rho_2^2}{(a+b)^2}\right)\sigma_v^2\right]$$

$$(31.2)\qquad E(G_c) = \frac{-1}{2a}\left[\left(\frac{b^2\rho_1^2}{(a+b)^2} - 1\right)\sigma_u^2 + \left(1 - \frac{b(2a+b)\rho_2^2}{(a+b)^2}\right)\sigma_v^2\right]$$

$$(31.3)\qquad E(G) = \frac{1}{2a}\left[\left(1 - \frac{b}{a+b}\rho_1^2\right)\sigma_u^2 + \left(1 - \frac{b}{a+b}\rho_2^2\right)\sigma_v^2\right]$$

Equations (31.1)–(31.3) yield essentially the same qualitative conclusions as those derived from Massell's perfect flexibility model. From the coefficients of σ_u^2, σ_v^2, one can infer the following.[12]

(i) Producers lose from price stabilization if the source of price instability is random shifts in demand, provided that these random disturbances are autocorrelated (either positively or negatively). They gain from having supply fluctuations stabilized, irrespective of their autoregressive properties.
(ii) Consumers lose (gain) from price stabilization if the source of price instability is random shifts in supply (demand).
(iii) The total gains from stabilization are always positive.

Note that if $\rho_i = 0$, so that all fluctuations are independently distributed through time, these gains are independent of the slope of the supply curve, depending only upon the slope of the demand curve and the variances σ_u^2, σ_v^2. Moreover, with $\rho_i = 0$, producers will be unaffected by having demand fluctuations stabilized; in that case all gains will accrue to consumers.

The conclusion that with rational expectations producers cannot gain (and will in fact lose if $\rho_1 \neq 0$) from having price stabilized for demand fluctuations is an extremely important one. It means that if producers are able to forecast efficiently, they are better off being able to exploit that information. This result contrasts with that obtained under adaptive expectations where it was shown that they would gain from stabilization unless demand fluctuations were highly autocorrelated. Hence, whether or not the Oi proposition extends to firms which base their supply decisions on expected prices depends to a large degree on the approach by which their forecasts are generated.

It is relatively straightforward to calculate how the welfare gains vary with the slopes of the demand and supply curves. In general $E(G_p)$, $E(G_c)$ can vary either way, and not surprisingly, the direction of response depends upon the origin of the stochastic price. Overall gains, however, vary inversely with both a and b, just as they do in the Massell model. Rather than report these calculations in detail, some limiting cases are again considered. Letting $a \to \infty$ (perfectly elastic demand), all gains tend to zero. On the other hand, as $a \to 0$ (inelastic demand), all the coefficients of σ_u^2, σ_v^2 in (31) become infinite (either positive or negative) with the gains from stabilization tending to become infinitely positive. By contrast, the corresponding limiting cases for the supply curve yield finite, non-zero gains or losses, unless $\rho_i^2 = 1$, in which case as $b \to \infty$, all gains tend to zero.

Letting G'_{ij} be defined analogously to G_{ij} in equations (21.1)–(21.3), and differentiating (31) with respect to the autoregressive parameters ρ_i,

$$(32.1) \qquad \operatorname{sgn} \frac{\partial E(G_p)}{\partial \rho_1^2} = \operatorname{sgn} G'_{11} < 0, \qquad \operatorname{sgn} \frac{\delta E(G_p)}{\partial \rho_2^2} = \operatorname{sgn} G'_{12} > 0$$

$$(32.2) \qquad \operatorname{sgn} \frac{\partial E(G_c)}{\partial \rho_1^2} = \operatorname{sgn} G'_{21} > 0, \qquad \operatorname{sgn} \frac{\partial E(G_c)}{\partial \rho_2^2} = \operatorname{sgn} G'_{22} < 0$$

$$(32.3) \qquad \operatorname{sgn} \frac{\partial E(G)}{\partial \rho_1^2} = \operatorname{sgn} G'_1 > 0, \qquad \operatorname{sgn} \frac{\partial E(G)}{\partial \rho_2^2} = \operatorname{sgn} G'_2 > 0.$$

Thus an increase in the absolute value of the autoregressive parameter, that is in $|\rho_i|$, will tend to reinforce the welfare propositions deduced from (31). In particular the total welfare gains will be increased making stabilization more desirable, and again, this is a result which did not necessarily hold under adaptive expectations.

Finally, comparing (31.3) with (12.3), the total gains from stabilization assuming rational expectations are at least as great as those obtained where the firm has perfect flexibility so that supply is a function of current prices. The instances in which the two expressions coincide are the limiting ones where $b \to 0$, $a \to \infty$, or $\rho_i \to \pm 1$. In general, one cannot deduce anything definite about the comparative gains under the two alternative sets of expectation hypotheses. For independently distributed disturbances they are equal, while if $\rho_i < 0$, one can show that the gains with adaptively formed expectations exceed those under rational expectations. On the other hand, for the more usual case of positively autocorrelated disturbances, nothing conclusive can be said without further knowledge of the parameters γ, b/a.

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[12] Strictly speaking, these statements hold except in the self-evident limiting cases, when the corresponding expressions reduce to zero.

Summary and Conclusions

This paper has extended the previous work of Waugh, Oi, Massell, and others, analyzing the gains from price stabilization, to the case where supply decisions must be made before the actual market price is known so that they must be based on some kind of price expectations. Two expectations generating mechanisms have been considered—the widely used "adaptive" expectations scheme and the efficient "rational" expectations hypothesis. The main results of the analysis may be summarized as follows.

(i) Whether or not the Oi proposition (which asserts that producers lose from price stabilization if the price instability originates with fluctuations in demand) continues to hold, depends crucially upon how the expectations are generated, as well as the autoregressive properties of the stochastic disturbances.

(ii) If expectations are formed rationally, the Oi result will continue to hold provided the demand fluctuations are either positively or negatively autocorrelated; if they are independently distributed, producers' welfare will be unaffected by the introduction of price stabilization.

(iii) The Oi proposition generally will not remain true if expectations are formed adaptively, unless the stochastic demand fluctuations are highly positively autocorrelated.

(iv) The parallel proposition for consumers, originally established by Waugh, will continue to hold under either form of expectations.

(v) Massell's result that stabilization provides a net gain to producers and consumers taken together also continues to hold in both cases. In fact one can derive the intuitively expected result that the gains from price stability are higher when supply is based on expected prices (again in both cases) than when it depends upon actual prices (perfect information).

(vi) Finally, essentially all of Massell's qualitative results remain unaltered under rational expectations, although some differences, including the modification to Oi's result, emerge with adaptive forecasting.

Several limitations of the analysis should be mentioned. First, all costs associated with operating the buffer stock have been ignored. While the buffer stock has been assumed to be self-liquidating, so that the expected net revenue of purchases and sales balances out to zero, there are other costs which have not been taken into account. These include storage costs, capital costs, and administrative costs and are discussed more fully by Massell [3]. Second, by focusing on expected profit, firms are assumed to be risk neutral. It is intuitively clear that if instead they are risk averse, the desirability of price stability will be increased. Third, all results are based on simple linear models. Finally, this has been strictly a partial equilibrium analysis. Stabilizing the price of one commodity will have repercussions in other markets which in turn will have feedbacks on the first market. The degree to which these interacting effects lead to a modification of the present results can only be assessed by extending the analysis to a general equilibrium framework.

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A Neoclassical Analysis of the U. S. Farm Sector, 1948–1970*

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The impacts of major exogenous forces on the farm sector are measured using a seven equation model. Annual estimates of the parameters of an aggregate Cobb-Douglas production function are obtained by using relative market shares. First order conditions for four groups of inputs are derived. Time series and ordinary least squares are used to estimate the supply for farm labor and the demand for farm output. Technological change, exogenous price changes, and population growth are the major exogenous influences. Roughly 90 percent of farm program benefits have accrued to landowners.

Key words: **secular trends; factor shares; program effects; cost-benefit.**

THE U. S. FARM SECTOR underwent massive change in the period following World War II. The farm labor force fell dramatically, but farm output increased by more than a third. Farming techniques changed rapidly as purchased inputs were substituted for labor inputs. Although land values soared and the hourly returns to farm labor more than doubled, many scholars, farm leaders, and farmers themselves felt that the welfare of farm families lagged behind that of urban dwellers. Billions of dollars were spent annually on farm programs designed, ostensibly, to bolster farm prices and incomes.

The massive changes occurring in the farm sector and the farm programs following in their wake have been the object of an enormous amount of research and speculation on the part of agricultural economists. Brief summary cannot do justice to the wealth of evidence and hypotheses contained in the resulting literature.[1] Suffice it to say here that the proposed explanations of changing resource use and farm price and income problems have focused attention on the atomistic structure of farm industries, price and income elasticities of demand, technological change, changing factor prices, farm labor immobility, asset fixity, irreversibility in supply response, high birth rates in rural areas, and more recently, on the disparities which exist among farms regarding quality of management and labor. Without doubt there are wide areas of agreement among writers on this subject, but the quantitative significance of the various hypothesized effects are often uncertain and sometimes hotly contested [2, 3, 21, 23, 28]. In explaining, for example, the decline in farm labor, how important has technological change been relative to changing factor prices? While many would agree that some farm program benefits become capitalized into the value of land, the extent to which benefits accrue to land versus labor appears to be in doubt. While several researchers have provided fairly consistent results as to the short run impacts of abandoning major farm programs, there seems to be less agreement on the estimates of long run impacts. Nor, finally, should one suppose that a consensus exists as to the appropriate qualitative analysis. In recent years, for example, some writers have called into question the conventional wisdom which asserts farm labor immobility [10, 15].

The present paper strives to improve understanding of the secular trends which prevailed in the farm economy over recent decades. The primary objective is to quantify the impact of exogenous forces, including farm programs, on the farm economy over the period 1948–70. The vehicle of analysis is a simple sector model used by R. G. D. Allen [1] as early as 1938 and recently applied to the analysis of farm programs by Floyd [9] and Gisser [11, 12]. The comprehensive and internally consistent model developed by Floyd and Gisser is first extended, and then estimates of the structural parameters are obtained.[2] Consideration is given to the empirical

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[1] For an excellent review see Brandow's recent survey [2].

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[2] The theoretical model is similar to the models of Floyd and Gisser in many respects. Floyd's farm sector model contained a production function, an output demand function, supply functions for land and labor, and two first order conditions. Gisser's model included a production function, an output demand function, supply functions for labor and capital, and two first order conditions. The main difference between the Floyd and

validity of the model. Simulation experiments are used to quantify the impacts of changes in technology, population, farm programs, exogenously-determined factor prices, and land on the levels of farm inputs, farmland rents, wage rates for farm labor, aggregate output, and prices received by farmers. Estimates of the impacts of farm programs are computed under alternative assumptions about resource fixity. Finally, the concepts of applied welfare economics are used to measure the loss in economic efficiency arising out of the interference of farm programs with resource allocation.

Quantification of an Aggregate Model

The theoretical model used in this analysis consists of equations (1)–(8) given below:

$$(1)\qquad Q = F(A, L, K, C)$$

$$(2)\qquad R = F_a P$$

$$(3)\qquad W = F_l P$$

$$(4)\qquad G = F_k P$$

$$(5)\qquad I = F_c P$$

$$(6)\qquad A = A(R)$$

$$(7)\qquad L = L(W)$$

$$(8)\qquad Q = D(P).$$

Equation (1) is an aggregate production function where Q, A, L, K, and C measure, respectively, aggregate farm output, land, labor, operating inputs (fertilizer, gas, chemicals, etc.), and capital inputs (machinery, buildings, livestock, etc.). An assumption embodied in equations (2) through (5) is that the price of each input is equated to its value marginal product where P, R, W, G, and I measure, respectively, farm output price, land rent, wage rate, price of operating inputs, and price of capital inputs. The partial derivatives of Q with respect to A, L, K, and C are given by F_a, F_l, F_k, and F_c, respectively. Operating and capital inputs are assumed to be in perfectly elastic supply so that their prices are exogenously determined. Equations (6) and (7) are the supply functions for land and labor, respectively, and equation (8) is the demand for output at the farm level.

Implementing the above model to explain variation that has occurred in the endogenous variables over the period 1948–70 requires several operations. Functional forms need to be specified. A correspondence between measured and theoretical variables must be established. Various equations need additional exogenous variables included to establish the linkages between the farm sector and the rest of the economic system. In addition the model must be revised to take into account government price support and related programs. Estimation of the parameters of the resulting model poses serious problems in that the parameters of equations (1) through (5) are likely changing over time in response to technological progress. This renders much of the formal econometric estimation techniques of limited usefulness.

The aggregate production function

For algebraic convenience, and in light of ample precedents in the literature, the functional forms are assumed to be multiplicative, and the aggregate production function is assumed to be a Cobb-Douglas form as in equation (9):

$$(9)\qquad Q = \alpha_0 A^{\alpha_1} L^{\alpha_2} K^{\alpha_3} C^{\alpha_4}.$$

The Cobb-Douglas specification precludes the possibility of regressive inputs, has the property of diminishing marginal physical productivity to all inputs over all levels of output, restricts the elasticity of substitution to a value of one, and specifies a complementary relationship among all inputs.

Technological change most likely changes the production function parameters over time. This renders regression analysis of time series data inappropriate, but there are at least two other approaches. The first, following Griliches and others, involves regression analysis of cross section data [13]. Since estimates are required for each year, this procedure was deemed impractical. A second and much simpler approach is based on a well-known property of Cobb-Douglas production functions, namely that α_i equals the ith input's relative market share; for example, in the case of land, $\alpha_1 = RA/PQ$. Applying this approach to the problem at hand involved estimating annual relative market shares for the four inputs for the period 1948–70. Estimates of the constant α_0 were computed for each year by plugging into equation (9) the estimates of the production elasticities and the annual values of the endogenous variables. The resulting estimates are given in Table 1. As noted, these estimates are pegged on the assumption that in each year, the price of an input is equated to its value of marginal product. No one would suppose that

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Gisser analysis and this study is at the level of empirical application.

Table 1. Annual estimates of the parameters of an aggregate Cobb-Douglas production function, U. S. farm sector, 1948–1970

	Parameters				
Year	α_0	α_1	α_2	α_3	α_4
1948	3.576	.1079	.3918	.2991	.2012
1949	3.623	.1144	.3703	.3070	.2083
1950	3.955	.1235	.3468	.3177	.2120
1951	3.738	.1225	.3359	.3144	.2272
1952	4.049	.1289	.3187	.3179	.2345
1953	4.355	.1362	.3223	.3194	.2221
1954	4.565	.1390	.3110	.3269	.2230
1955	4.811	.1456	.3006	.3216	.2323
1956	4.989	.1474	.2941	.3307	.2279
1957	5.083	.1515	.2773	.3288	.2424
1958	5.508	.1575	.2647	.3273	.2505
1959	5.586	.1666	.2580	.3259	.2496
1960	6.022	.1758	.2502	.3203	.2536
1961	6.134	.1718	.2464	.3286	.2532
1962	6.417	.1741	.2364	.3342	.2554
1963	6.629	.1855	.2280	.3295	.2570
1964	6.834	.1937	.2169	.3336	.2557
1965	7.338	.2010	.2090	.3310	.2590
1966	7.127	.2003	.2020	.3309	.2668
1967	7.787	.2132	.2012	.3159	.2698
1968	7.589	.2131	.2000	.3163	.2706
1969	7.973	.2171	.2004	.3093	.2732
1970	8.040	.2158	.1973	.3092	.2777

the pricing system operates in so perfect a manner. The question is whether or not the resulting approximation is tolerably close to the real world. The traditional way (and some have argued the only way) to test the realism of economic models is through comparing their implications with observations. According to this test, the estimates given in Table 1, along with others to be presented, will be shown to stand up quite well.

Obtaining values for the variables used in computing market shares and in estimating other parameters of the model was straightforward in most cases. For annual farm price, *P*, the series used was the USDA index of prices received by farmers for all farm products divided by the value of the index in 1957.[3] Deflating an adjusted series on total farm marketings by the series on prices received gave a series on the quantity of farm output, *Q*, in constant 1957 dollars.[4]

The total net imputed returns to all land inputs was obtained by multiplying the value of farmland by the farm mortgage interest rate [26]. Property taxes on land[5] were added to net imputed returns in order to obtain gross total returns to farmland. The gross rent per acre, *R*, equals total gross returns divided by the sum of acres planted plus acres diverted. Land inputs, *A*, equals the USDA series on acres planted to 59 crops [26].

Labor input, *L*, equals the total hours used for farm work by all farm workers, including hours of labor used on crops, livestock, and overhead [6].[6] The farm wage rate, *W*, equals the composite wage rate paid to hired farm workers.[7]

The prices and quantities of operating and capital inputs were obtained less directly. Total current expenditures on operating inputs is based largely on the USDA series "Current Farm Operating Expenses" [26]. Like the USDA series it includes expenditures on fertilizer and lime; petroleum, fuel, and oil; the processing component of intrasector purchases; miscellaneous purchases; and repairs and operation of capital equipment. However, adjustments were made in the USDA series to exclude net intrasector purchases, expenditures on hired labor, interest on nonreal estate debt, and property taxes on farm real estate.[8] To get operating inputs in constant 1957 dollars, *K*, total expenditures on operating inputs were adjusted by a weighted average of the prices of individual operating inputs. Like the price of output, the weighted price deflator was computed relative to the 1957 value of the index.[9]

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[3] The series on prices received was taken from various issues of [26].

[4] Total farm marketings had been computed by subtracting three items from the USDA series on Total Gross Farm Income: (1) direct payments to farmers, (2) the imputed rent on farm dwellings, and (3) the intrasector sales of feed, seed, and livestock. The imputed rent on farm dwellings was excluded since it represents income to the family, but not income to the farm as a productive unit. Double-counted intrasector sales were eliminated in order to get at a net sales figure for the farm sector. Data on gross farm income, direct payments, and the imputed rent on farm dwellings are available in the July issues of [7]. Processing expenses on intrasector sales were obtained from unpublished USDA sources.

[5] Total property taxes on farm real estate [26] were allocated to land and buildings in proportion to the value of these items.

[6] The USDA series on labor inputs is a constructed series based on man-hour requirements in agriculture; it is not based on empirical observations. However, trends in man-hour requirements do not differ markedly from trends in farm employment over the 1948–70 period. Man-hours is used rather than the employment series because the former is thought to contain less error (see [24, p. 629]).

[7] This approach assumes that the hourly return to family labor and hired labor is the same. A recent study [17] found that the 1972 level of return to farm operators was $1.49, which is only slightly above the 1970 composite wage rate.

[8] The exclusion of intrasector purchases is consistent with the exclusion of intrasector sales on the income side. Expenditures on hired labor are included in the wage bill. Property taxes on farmland were included in land's share. The interest on nonreal estate debt is included in capital's share.

To obtain a series on real capital inputs, C, a constructed price series was used to deflate the total returns to capital inputs to get a series in constant 1957 dollars. The total returns to capital inputs equals the sum of the imputed returns to farm buildings, farm machinery and equipment, farm vehicles, crops in inventory, livestock, and the deposits and currency of farm firms. For each item a net return was imputed by multiplying the stock value of the input by an appropriate interest rate. Depreciation allowances and property taxes were added to net returns to get gross returns.[10] The price of capital, I, was computed as the weighted average of the prices of individual capital inputs.[11] It was assumed in each case that the price of the capital input was proportional to the price of new investment goods.

It should be noted that the market shares computed separately did not sum in any year to the exact total of market receipts. In the early years the resulting discrepancies were, for unknown reasons, rather substantial. Since 1953, however, the sum of the factor shares was generally within 5 percent of the actual value of farm output. The relative market shares given in Table 1 were computed by dividing individual market shares by their sum; this imposes the assumption of constant returns to scale on the model. Estimates based on the alternative of dividing market shares by the value of farm output proved to be less reliable, relatively, in "explaining" variation in the endogenous variables and are therefore not reported.

Given the estimates of the parameters of the production function, the parameters of equations (2), (3), (4), and (5) can also be deduced.

The supply of land

The amount of land farmed is assumed to be in perfectly inelastic supply with government acreage diversion programs being the main shifter. Although it is nearly certain that total acreage farmed is sensitive to the level of rents in the long run, a long time lag for adjustment is assumed. Over the period of interest here, land farmed plus acres diverted remained remarkably stable. The index of planted plus diverted acres equaled 100.0 in 1948 and 99.7 in 1970 with 1957 as the base year. The impact of acreage diversion programs is taken into account by simply using planted acreage as the land input. The time series for land and other exogenous variables, including a farm program parameter to be explained later, are given in Table A.1 of the appendix.

The supply of farm labor

Microeconomic theory suggests many potential shifters of the supply function for labor in agriculture including the nonfarm wage rate, tastes and preferences, unemployment rates, and size of the farm population. Using ordinary least squares and time series data for the period 1929–1970, the accepted estimate of the labor supply function was:

(10)

$$W = (.00807)\ \underset{(3.679)}{(L)^{.387}}\ \underset{(20.463)}{(N)^{1.363}} \qquad R^2 = .98$$

where W and L are defined as previously, and N equals average weekly earnings of workers employed in manufacturing industries in the U. S. [27]. The estimated parameters have the right signs, and the t-ratios, given in parentheses, are satisfactory. Estimates based on data for 1948–1970 were judged unacceptable. Multicollinearity is the likely culprit. The correlation between L and N over the period 1948–1970 was .98. Some experimentation with models in which lagged values of W were inserted as an independent variable, with L dependent, yielded unsatisfactory results. The elasticity of labor supply with respect to farm wage rate equals 2.6. This estimate falls within the range of 1.0 to 3.33 used by Gisser [11, 12] in his work on farm labor but exceeds estimates by other researchers [20, 25]. Importantly, the explanatory power of the overall model fell substantially when an inelastic labor supply function was included.

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[9] The price series used in the weighting process included the Index of Fertilizer Prices, Composite Index of Prices Paid by Farmers, Index of Prices of Motor Supplies, Index of Prices of Feed Purchases, and Index of Prices Paid for Machinery (see [26]).

[10] Property taxes on vehicles, machinery, and equipment; farm buildings; and household items were computed from data in [5, 26]. Taxes on household items were excluded from capital expenses since they are not a cost of production. Estimates of depreciation are available in [7].

[11] The prices included in the weighting scheme were the Index of Prices Paid for Building Materials, Index of Prices Paid for Machinery and Equipment, Index of Prices Paid for Vehicles, Index of Prices Paid by Farmers, and Index of Prices Received by Farmers (which is the cost of holding inventory). (See [26] for the data.)

Aggregate demand for farm output at the farm gate

A considerable effort was made to obtain estimates of demand parameters using time series data and ordinary least squares. Farm output (price received) was treated as the dependent (independent) variable in some cases and as the independent (dependent) variable in others. Output demanded was adjusted in various ways in light of storage, exports, and government withdrawals. Independent variables included U. S. population, per capita income, and world food production. The demand equation finally selected was as follows:

$$(11) \qquad Q = 113.4\,(P)^{-0.1}\,(H)^{1.079}$$

where Q and P are defined as before, and H equals U. S. population. The genesis of this equation merits further explanation. The parameter estimates are based on regression analysis of data for 1948–1970 *except* that the exponent for P, -0.1, was chosen rather arbitrarily. The t-ratio for H was 23.23 and $R^2 = .965$. Regression analysis yielded a positive estimate for demand elasticity with an exceedingly small t-ratio. Positive elasticity was rejected on both *a priori* and statistical grounds. Using the entire model, experiments were conducted with price elasticities ranging from zero to -0.5. The explanatory power of the model was fairly insensitive to changes in demand elasticity, but the value -0.1 yielded somewhat better results. It is worth stressing that over the period 1948–1970, per capita farm production was very stable.[12] This plus the results referred to above suggest that population "explains" so much of the variation in output that very little is left for other explanatory variables such as price or per capita income. It was concluded that over the period 1948–1970, population was the major demand shifter and that other shifters were relatively unimportant. Quite possibly, however, the estimated exponent for H may reflect the impacts of rising per capita incomes and increases in foreign trade.

A special interpretation of equation (11) is required in light of commodity acquisition, storage, and disposal by the Commodity Credit Corporation (CCC). These transactions create discrepancies between total farm output and total purchases by private buyers. Measuring the discrepancy is difficult for a variety of reasons including the likelihood that CCC storage lowers commercial storage and the possibility that noncommercial sales compete with commercial sales in foreign markets. Two measures of net government withdrawals are therefore used. The first is PL 480 sales abroad. The second is gross CCC acquisitions.[13] It is hoped that these measures will generally provide the lower and upper limits on net withdrawals.

Net withdrawals are introduced into the model by assuming that total farm output, Q, equals total private purchases, Q^*, plus net withdrawals (see [14]). The proportion of output which is withdrawn from the market in any year is given by θ where θ is computed by dividing net government withdrawals by total farm output. Total purchases in any year are therefore equal to $Q = Q^*/(1 - \theta)$. The elimination of CCC-related programs is then accomplished in the simulation experiments by, in effect, scaling down the intercept term of the demand equation.

The quantified model

To sum up, the model of U. S. agriculture here proposed is given by equations (12) through (18) where "hats" are used to indicate estimated values.

$$(12) \qquad \hat{Q} = \alpha_0(A)^{\alpha_1}(\hat{L})^{\alpha_2}(\hat{K})^{\alpha_3}(\hat{C})^{\alpha_4}$$

$$(13) \qquad \hat{R} = F_a\hat{P}$$

$$(14) \qquad \hat{W} = F_l\hat{P}$$

$$(15) \qquad G = F_k\hat{P}$$

$$(16) \qquad I = F_c\hat{P}$$

$$(17) \qquad \hat{W} = (.00807)(\hat{L})^{.387}(N)^{1.363}$$

$$(18) \qquad \hat{Q} = (113.4)(\hat{P})^{-.01}(H)^{1.079}$$

For any one year in the period 1948–70 the α parameters are to be taken from Table 1. Inserting the values for the exogenous variables and the government parameters then gives rise to a system of seven equations and seven unknowns. In this manner the model may be used to estimate the seven endogenous variables for each year during the entire period. Using the model to project future values of the endogenous variables would entail projecting exogenous variables, technical parameters, and government policy parameters.

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[12] The volume of farm output rose 43.6 percent between 1947–50 and 1968–71 while the population was increasing by 37.8 percent. Thus, output increased only slightly faster than population despite a 29 percent decline in real farm prices and a 64 percent increase in real disposable income per capita.

[13] PL 480 exports are assumed equal to "Exports Under Specified Government Programs" [8]. Gross CCC acquisitions equaled acquisitions through direct purchase plus acquisitions via loan programs. The series on Total Acquisitions was constructed using the data on CCC inventory transactions from various issues of [26].

The actual and estimated values of all endogenous variables are given in Table 2. "Goodness of fit" is assessed through expressing for each variable for each year the absolute difference between the actual and predicted value as a percentage of the actual value. The average percentage deviation for the entire period equaled 3.0 for labor, 3.6 for operating inputs, 3.6 for capital, 3.2 for rent, 5.3 for wages, 2.0 for output, and 5.9 for price. The model appears to perform quite well. Certainly the dramatic changes which have occurred in resource use and in input prices can be explained in large measure by the hypotheses implicit in the model. This leads to the conclusion that the impacts of exogenous forces can be determined, at least in a rough fashion, through simulation experiments on the model. Although the model appears to explain fairly well the changes occurring over the period 1948–1970, there is no assurance that it would perform equally well for other periods. For example, the period here under study was free of major shifts in demand arising out of major depressions or acute world food shortages. Clearly the model would require additional linkages between the farm and nonfarm sectors to reflect such calamities.

Estimated Impacts of Changing Exogenous Factors

Changes in the endogenous variables are due to changes in technology, government programs, population, input prices, and the supply of land. How much of the total change in each endogenous variable from 1948 to 1970 was accounted for by each exogenous factor? Unfortunately, answering this question is complicated somewhat in the present work because both parameters and exogenous variables are changing from year to year. If the parameters were stable, then the causes of change in the endogenous variables could easily be quantified using the system's reduced form equations. However, since the farm sector's technical parameters change from year to year, the reduced form coefficients will also be changing. The problem thus becomes whether to weight the changes in the exogenous variables using the technical parameters of 1948 or those of 1970. As with all index number problems, there is no perfect solution to the problem posed here.

To illustrate, suppose the total change in labor inputs from period 1 to period 2 as given by the reduced form equations is $(\hat{L}_2 - \hat{L}_1)$ and that one wishes to determine whether the change is due to variation in an exogenous variable X_t or to the variation in the coefficient associated with X_t, that being π_t. If only X_t had changed, then the *ceteris paribus* change in L_t would equal $Z_x = \pi_1 (X_2 - X_1)$. Likewise, the *ceteris pari-*

Table 2. Actual and predicted values for the endogenous farm variables, 1948–1970

	Endogenous Farm Variables[a]													
	Labor		Operating Inputs		Capital		Rent		Wages		Output		Price of Output	
Year	L	$\hat{L}$	K	$\hat{K}$	C	$\hat{C}$	R	$\hat{R}$	W	$\hat{W}$	Q	$\hat{Q}$	P	$\hat{P}$
	(millions of hours)		(millions of real dollars)		(millions of real dollars)		(dollars per acre)		(dollars per hour)		(millions of real dollars)		(Index, 1957 = 100)	
1948	16833	17438	7973	7149	5758	5236	7.47	7.02	.530	.520	25623	24655	1.221	.950
1949	16202	15936	8203	7448	5849	5109	7.66	6.99	.559	.519	24967	25296	1.064	.882
1950	15137	15040	8401	8366	5961	5768	8.56	8.56	.561	.565	25617	25542	1.098	.959
1951	15209	15572	8849	9195	6671	6517	9.55	10.37	.625	.643	25163	25504	1.285	1.170
1952	14442	14353	9053	8995	6886	6454	10.84	10.96	.661	.672	26287	26001	1.226	1.164
1953	13870	13344	9120	9101	6840	6586	10.93	10.98	.672	.702	27474	26641	1.085	1.090
1954	13310	12682	9129	8994	6847	6730	11.08	11.00	.661	.688	27958	27310	1.047	1.027
1955	12808	11488	9377	9060	7021	7199	11.84	11.48	.675	.730	28775	27896	.987	1.000
1956	12028	11159	9659	9610	6921	6830	12.38	12.35	.705	.758	29154	28389	.979	1.013
1957	11059	10794	9546	10049	7088	7409	13.30	13.99	.723	.785	28259	28804	1.000	1.061
1958	10548	10285	9817	9898	7162	7219	14.59	14.77	.757	.786	29248	29395	1.064	1.039
1959	10301	9934	10241	10538	7195	7214	16.12	16.52	.798	.848	29615	29825	1.021	1.094
1960	9795	9563	10116	10280	7367	7479	17.34	17.74	.818	.856	30439	30507	1.017	1.072
1961	9400	9227	10199	10462	7299	7414	17.71	18.26	.834	.876	30896	31110	1.021	1.054
1962	8979	8616	10560	10747	7368	7420	18.88	19.25	.856	.909	32033	31647	1.038	1.046
1963	8664	8349	10564	10786	7504	7615	20.33	20.83	.830	.939	31779	32068	1.034	1.071
1964	8194	7959	10891	11213	7629	7847	21.79	22.56	.904	.962	31891	32522	1.008	1.085
1965	7775	7424	11068	10892	7950	7862	23.38	23.26	.951	.991	33619	33021	1.055	1.066
1966	7381	7344	11537	11563	8343	8398	25.33	25.64	1.030	1.048	33129	33200	1.132	1.147
1967	7269	7097	11728	10832	8728	8076	27.32	25.46	1.120	1.069	35479	33637	1.081	1.119
1968	7005	7044	12318	11677	8781	8401	29.32	28.34	1.210	1.163	34716	33779	1.111	1.213
1969	6695	6782	12507	11432	8875	8580	32.21	30.29	1.310	1.234	35619	34113	1.166	1.224
1970	6522	6696	12724	11429	9071	8240	33.70	31.30	1.420	1.285	36384	34394	1.191	1.267

[a] "Hats" are used to indicate estimated values.

bus change due to variation in π_t is $Z_\pi = X_1 (\pi_2 - \pi_1)$. The sum of the *ceteris paribus* changes, $Z_x + Z_\pi$, clearly is not equal to the actual change. So long as the technical parameters are changing, this bias cannot be eliminated. The bias can be reduced, at least under certain conditions, by computing *ceteris paribus* changes on a year-to-year basis and then summing these changes over all years for each causal factor.[14] In the present application the sum of such changes using the yearly-breakdown method was very nearly the same as the actual change for each endogenous variable. Results of the analysis are given in Table 3; the figures in this table have been adjusted proportionally to correct for the remaining bias. Whether PL 480 sales or gross CCC purchases are taken as the estimate of net government withdrawals makes little difference in this part of the analysis. The results in Table 3 are based on PL 480 sales.

Several important conclusions can be derived from the results given in Table 3. Technological change has tended to decrease all endogenous variables except rent and output. The magnitudes of the resulting changes were substantial, especially in the case of labor, operating inputs, and prices received by farmers. Apparently the large increase in α_0 (it more than doubled) coupled with a highly inelastic demand function caused both operating inputs and capital to decline even though their production elasticities were increasing. The changes in farm inputs due to changes in exogenous input prices, including the nonfarm wage rate, were also substantial, though less in absolute value than were those for technology. Among the various exogenous forces the exogenous input price changes had the greatest impacts on rents, wages, and output price. If the farm problem is viewed as a labor-transfer problem, then changes in technology and exogenous input prices are the main causes.[15] The technology and input price effects taken together easily swamp the favorable demand or population effect. Clearly, the most important factor in increasing farm wage rates is the increasing wage rates in the nonfarm sector. Population change, plus perhaps per capita income change as well, appears to have had large positive impacts on all endogenous variables. It has in particular dwarfed the impacts of other exogenous changes on the level of farm output. The changes in farm programs between 1948 and 1970 have served to increase land rents modestly, but other variables

Table 3. Cumulative impacts of year-to-year changes in exogenous factors on endogenous variables over the period 1948–1970

	Endogenous Variables						
Exogenous Factors	Labor	Operating Inputs	Capital	Rent	Wages	Output	Price of Output
Technological Change	—8684	—5627	—353	4.39	—.226	1138	—.448
Farm Programs	423	616	361	3.33	.010	360	.042
Exogenous Input Prices	—6313	3662	—57	9.06	.872	—1579	.612
Population	3823	5621	3049	7.37	.102	9820	.114
Land Supply	8	8	4	.13	.001	0	—.003
Total Estimated Change Between 1948 and 1970[a]	—10742	4280	3004	24.28	.759	9739	.317

[a] These data are computed from Table 2.

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[14] For example, when the total change from year 1 to year 3 is given by $(L_3 - L_1) = \pi_3 X_3 - \pi_1 X_1$, then using the yearly-breakdown method, $V_x = \pi_2 (X_3 - X_2) + \pi_1 (X_2 - X_1)$ is the change due to variation in X_t, and the change due to variation in π_t may be computed as

$$V_\pi = X_2 (\pi_3 - \pi_2) + X_1 (\pi_2 - \pi_1).$$

It can be shown that the bias resulting from using the year-to-year breakdown is less than in the case where only beginning and ending year values are used, so long as there is a consistent trend in the exogenous variables and parameters. This condition is generally satisfied in the present model.

[15] In a 1957 paper T. W. Schultz argued that "the hard core of the United States farm problem is a labor-transfer problem" [21, p. 14]. He went on to conclude that three classes of effects, viz., demand effects, input quality effects, and substitution effects, were responsible for the problem. This analysis classifies the effects in a slightly different way, recognizing, as did Schultz, that technological change as well as changes in factor prices can cause substitution to occur, and in light of the imperatives of quantification.

were not much affected. Changes in the land supply other than those accounted for by farm programs had, as expected, insignificant impacts.

Estimated Impacts of Farm Programs

Changes in endogenous variables

The impacts of farm programs on the farm economy were assessed by comparing the simulated values of the endogenous variables with and without farm programs. The mechanics of eliminating programs from the model were straightforward. Diversion programs were removed by simply adding the diverted acres to acres planted.[16] Some exogenous variation in total acreage still existed, however. Net CCC withdrawals of farm output from the commercial market were expunged through scaling down the constant term of the demand equation. As noted, PL 480 sales and gross CCC purchases are used as alternative estimates of net government withdrawals. Thus there are two sets of simulated values of the endogenous variables in the absence of government programs. The results are given in Tables A.2 and A.3 in the appendix. The two tables depict the development of the farm sector, assuming that no programs had ever been enacted.[17]

Using the data given in Tables 2, A.2, and A.3, the differences between the simulated values of a variable with and without farm programs were computed and expressed as percentages of the values with farm programs in effect. The two sets of "free market" values allow interval estimates for the percentage changes in endogenous variables. The resulting figures are given in Table 4.

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[16] An anonymous reviewer has called attention to the likelihood that diverted acres tend to be less productive than planted acres. Assuming that diverted acres were only 85 percent as productive as planted acres had very little effect on estimates of the impacts of government programs except in the case of rent to land. To the extent this assumption is correct, the estimates in this study of free market rents are probably biased *upward* by 2 to 3 percent over the last several years of the period under study.

[17] Another relevant question concerns the impacts of farm programs on the variability of endogenous variables. Since dynamic considerations are given short shrift in this analysis, the results do not shed much light on the issue of stability.

Table 4. Interval estimates of percentage increases in endogenous variables caused by farm programs, 1948–1970

	Endogenous Variables					
Year	Labor	Operating Inputs (or Capital)[a]	Rents	Wages	Output	Price of Output
			Percent			
1948	.0– 5.2	.0– 7.2	.0– 7.1	.0–2.1	.0– 5.6	.0–1.7
1949	.0– 9.5	.0–12.9	.0–12.9	.0–3.9	.0–10.3	.0–2.8
1950	.0– 6.2	.0– 8.4	.0– 8.4	.0–2.5	.0– 6.6	.0–2.0
1951	.0– 1.8	.0– 2.4	.0– 2.5	.0– .6	.0– 1.9	.0– .5
1952	.0– 1.4	.0– 1.9	.0– 1.9	.0– .4	.0– 1.5	.0– .4
1953	.0– 6.5	.0– 8.9	.0– 8.8	.0–2.6	.0– 6.9	.0–2.0
1954	.9– 9.1	1.2–12.5	1.3–12.5	.3–3.6	.9– 9.8	.3–2.9
1955	3.6–11.4	4.9–15.5	4.9–15.5	1.5–4.7	3.8–12.2	1.2–3.8
1956	5.9–10.0	8.1–13.6	11.6–16.9	2.2–4.0	5.8–10.1	2.5–3.8
1957	5.9– 8.8	8.1–12.0	15.2–18.8	2.3–3.4	5.1– 8.3	3.1–4.1
1958	4.6– 7.1	6.3– 9.8	13.5–16.7	1.8–2.8	3.7– 6.4	2.7–3.6
1959	4.5– 5.2	6.2– 7.1	12.2–13.1	1.8–2.0	3.7– 4.4	2.6–2.8
1960	5.5– 9.0	7.6–12.2	15.1–19.4	2.1–3.5	4.4– 8.0	3.4–4.6
1961	6.5– 7.7	8.9–10.5	22.4–23.8	2.6–3.1	4.2– 5.5	4.8–5.3
1962	6.8–10.5	9.3–14.2	25.5–29.5	2.8–4.2	3.9– 7.9	5.5–6.8
1963	6.8– 9.9	9.3–13.4	23.3–26.8	2.8–4.0	4.1– 7.4	5.4–6.4
1964	7.4– 8.7	10.1–11.9	24.1–25.6	2.9–3.5	4.5– 6.0	5.8–6.3
1965	6.4– 7.3	8.7–10.1	23.2–24.3	2.5–2.9	3.2– 4.3	5.6–6.0
1966	6.5– 6.6	8.9– 9.1	24.8–25.0	2.6–2.7	3.0– 3.2	6.0–6.1
1967	4.6– 5.2	6.3– 7.2	17.0–17.8	1.8–2.1	2.1– 2.8	4.3–4.5
1968	5.5– 6.8	6.6– 7.8	19.4–20.5	2.2–2.7	1.8– 2.8	4.9–5.2
1969	5.5– 6.8	7.6– 9.3	22.6–24.0	2.2–2.7	1.9– 3.2	5.8–6.3
1970	5.4– 5.8	7.4– 8.0	22.1–22.7	2.1–2.3	1.8– 2.3	5.6–5.8

[a] The assumptions of the model imply that the percentages for operating inputs and capital will be the same. Computations were consistent with theoretical expectations.

The major conclusions to be drawn from these figures are as follows: First, while wage rates and to a lesser extent price of output were close to free market levels over the last several years of the period, rents ran substantially higher.[18] It is estimated, for example, that in 1970 rent was about 22.4 percent above the free market level; the corresponding percentages for wage rates and price of output were roughly 2.2 and 5.7 percent, respectively. This suggests that the major beneficiaries of farm programs have been landowners and not the suppliers of labor. In this connection D. Gale Johnson [16, p. 337] inquired nearly a decade ago, "Is it not possible that the elasticity of supply of farm labor is so high that price supports and acreage limitations have little effect on the average return to labor engaged in agriculture?" The belated reply is that if he means by "little" two to three cents per hour, then the answer is "yes" although it should be noted that a good deal more than the elasticity of labor supply is involved. For comparison, the simulated annual changes in free market wage rates between 1948 and 1970 (using Table A.3) averaged a little over three cents an hour.

Second, the impacts of farm programs on the input mix were quite substantial. Two forces were at work. The CCC programs and other price support operations tended of themselves to increase the quantities of farm inputs. In addition the retirement of farmland under diversion programs led to the substitution of other inputs for land. The result was a level of labor, capital, and operating inputs that was generally 5 to 8 percent above free market levels in recent years. The increase in output was less, about 2 percent above free market levels.

For a few miscellaneous observations, the two alternative methods of measuring net CCC withdrawals gave rise to rather wide interval estimates for the earlier years. It is interesting to note, however, that the simulated values for the Korean War period (using Table A.3) were very close to free market levels. Also, it appears that the big increases in land rents above free market levels were due to the reliance on diversion programs in the 1960s. Neither of the latter two results was unexpected. Finally, since the early sixties the endogenous variables seem to have moved closer to free market levels.

Functional distribution of farm program benefits

One of the most crucial questions in the literature on farm policy concerns the extent to which program benefits accrue to landowners as opposed to labor. By assumption, farm programs in the present analysis may affect land and labor prices but not the prices of other inputs. As has been shown, land and labor prices were increased. Benefits are defined as the area above the input supply function and between the free market price and the price prevailing under the programs. In other words, benefits are defined to exclude opportunity costs of inputs. The exclusion pertains mainly to labor, of course, since land is assumed to have no nonfarm alternatives. The results are given in Table 5. A separate breakdown of benefits resulting from land diversion programs is also provided.

In recent years benefits to land accounted for about 92 percent of total benefits. This is in contrast with earlier years when, assuming gross CCC purchases equaled net withdrawals, the benefits were more equally distributed between land and labor. The estimates in this study indicate that the land diversion programs aimed at lowering commodity surpluses have also had the effect of shifting benefits to land in a fairly dramatic fashion. In 1970, for example, 95 percent of land diversion benefits and 80 percent of the remaining farm program benefits accrued to landowners.

Terminating farm programs

The above discussion of benefits compares the farm sector under programs with the farm sector if programs had never existed. A rather different though equally important question concerns the loss in benefits if programs were suddenly terminated. As shown, farm programs have relatively little impact on total output and prices received but the input mix has been seriously affected. According to the fixity argument, considerable time might be required in order to achieve the free market input mix.[19] But to what degree is the fixity argument valid? It is reasonable to assume that operating inputs can be adjusted quickly. Evidence also suggests that labor adjusts at a fairly rapid rate. Where the fixity argument is most germane is in the case of land and farm capital. A sudden abandonment of farm programs could be expected to destroy substantial

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[18] According to Tweeten [22], approximately one-third of land value gains from 1950 to 1963 was due to farm programs. This coincides fairly well with the estimate of 39 percent obtained in this study.

[19] The fixity arguments, pro and con, are summarized in [23].

Table 5. Functional distribution of farm program benefits, millions of dollars, 1948–1970

				Benefits of Farm Programs[a]					
	Benefits of Diversion Programs			Gross CCC Purchases Equal Withdrawals			PL 480 Sales Equal Withdrawals		
Year	Land	Labor	Total	Land	Labor	Total	Land	Labor	Total
1948				179.9	184.2	364.1			
1949				572.0	298.9	870.9			
1950				254.3	201.3	455.6			
1951				90.7	66.5	157.2			
1952				74.8	48.7	123.5			
1953				349.7	232.2	581.9			
1954				486.1	303.0	789.1	49.7	27.8	77.5
1955				629.6	364.2	993.8	198.1	117.6	315.7
1956	196.4	14.1	210.5	746.1	320.2	1066.3	510.5	189.0	699.5
1957	452.0	32.4	484.4	943.4	282.3	1225.7	760.4	190.3	950.7
1958	465.6	31.8	497.4	867.6	219.6	1087.2	701.9	142.2	844.1
1959	439.9	29.6	469.5	760.1	166.9	927.0	710.8	146.6	857.4
1960	600.3	38.8	639.1	1207.6	278.1	1485.7	939.2	172.1	1111.3
1961	1155.7	71.1	1226.8	1572.4	237.3	1809.7	1481.8	201.8	1683.6
1962	1473.0	84.3	1557.3	2070.9	310.7	2381.6	1786.5	203.9	1990.4
1963	1394.1	79.1	1473.2	2024.1	296.0	2320.1	1756.2	204.5	1960.7
1964	1514.1	79.7	1593.8	2070.3	255.2	2325.5	1948.3	215.1	2163.4
1965	1620.4	81.4	1701.8	2047.2	206.6	2253.8	1953.2	179.2	2132.4
1966	1959.7	94.6	2054.3	2317.0	195.9	2512.9	2298.9	190.9	2484.8
1967	1351.9	63.7	1415.6	1612.3	132.7	1745.0	1687.2	152.4	1839.6
1968	1719.1	84.1	1803.2	1969.3	148.2	2117.5	2080.1	178.8	2258.9
1969	2165.8	105.2	2271.0	2601.9	217.2	2819.1	2444.6	177.4	2622.0
1970	2192.7	105.1	2297.8	2536.1	191.4	2727.5	2475.3	176.7	2652.0

[a] These include benefits of diversion programs.

land value. Moreover, farm capital in the form of buildings and equipment cannot readily be adjusted downward. While farm capital can be maintained or increased with relative ease, a contraction to the free market level could entail several years and mean significant losses to farm capital owners.

For these reasons an estimate was obtained of the short-run loss in benefits to the farm sector in the event farm programs were suddenly scrapped. To allow comparison with other studies, the year 1964 was chosen. Endogenous variables were simulated without farm programs and holding farm capital constant at its with-farm-program value. Total benefits lost, computed by adding together the loss in benefits to landowners and to labor and the imputed loss on capital inputs, equaled $3,776 million. This amounts to 37 percent of total benefits to land and labor in 1964. This estimate is quite consistent with estimates provided by previous research. In a survey of five studies aimed at measuring the short run impacts of the elimination of farm programs on net farm income in the early sixties, Brandow concludes that the median estimated percentage decline was 37 percent [2]. Of course the measure of benefits in this study does not equal net farm income. The important point, however, is that regardless whether the benefit or income concept is used, available findings suggest that an abrupt termination of programs during the decade of the sixties would have had a very serious impact on the welfare of farm families.

Loss in economic efficiency, 1970

It has long been argued that farm programs give rise to various sorts of economic inefficiencies. The retirement of farmland in favor of other inputs leads to an inefficient input mix. Price supports lead to overproduction, which must either be stored or dumped in foreign markets. Domestic consumers obtain less output than in competitive equilibrium and pay a higher price for it. The measure of economic efficiency used here is the net willingness of society to pay for farm programs. Net willingness to pay may be defined in the present application as the willingness on the part of beneficiaries to pay for benefits received minus the compensation consumers and taxpayers would receive in order to be maintained at free market levels of utility. On the assumption of parallel indifference curves for workers and landowners, willingness to pay for benefits received equals the area above the input supply curve and between the program and free market input prices.[20] This, of course, is exactly the measure of benefits adopted above. Willingness to pay for benefits in 1970 equaled roughly $2,689 million. Assuming parallel indifference curves for consumers, compensation required by consumers equals the area below the demand curve and between the program and free market prices. In 1970 this area equaled the rather modest sum of $240 million. Adding to this figure the government expenditures for farm income support in the same year yields a total of $4,829 million which is taken as the measure of compensation required by both consumers and taxpayers. Net willingness to pay equaled a minus $2,140 million. This, then, is the measure of loss of economic efficiency resulting from farm programs in 1970. For every dollar of benefits engendered by farm programs, 92 cents of which accrued to landowners, society incurred a loss in economic efficiency amounting to 80 cents. In his survey of farm policy literature, Brandow [2] concluded that the social cost of programs was small in relation to value of total output. The estimate of social cost in this study equals 5 percent of the value of farm output in 1970. Whether the dead-weight loss is excessive or not depends on welfare judgments regarding the redistributive effects and alternative redistribution schemes.

A Postscript

Many economists harbor dark suspicions regarding the welfare implications of farm programs, and the above analysis might well confirm some of these suspicions. An important question to be asked, however, is what has a succession of congresses and administrations hoped to achieve through these programs? Government intent in this area is not easy to fathom. If the objective has been to increase incomes of farm operators and their families, the programs have to a large extent been successful. As of 1969, about 87 percent of farm operators were also landowners. Their incomes have been enhanced not only through higher implicit wage rates but, more importantly, through higher implicit rents on their land holdings. Even so, the critic can rightly point to the concentration of benefits among the richest farmers and to alternative schemes such as the negative income tax that would channel the largest benefits to the poorest farmers. Of greater relevance to this study are the long run implications. As present landowners sell their land holdings, future program benefits to land become capitalized into land values. Future generations of farm operators merely obtain the niggardly program benefits that accrue to their labor. In this regard Wilcox [28] has argued that land ownership changes hands very slowly, that up until 1964 at least, benefits had gone mainly to farm operators. Updating Wilcox's analysis suggests that at present 30 to 40 percent of all farmland has been purchased since 1953. This suggests that in all likelihood, much of the future benefits of farm programs have already been capitalized into land values. As of 1970, an abrupt termination of farm programs might not only have entailed sharp losses in farm income, it might also have bankrupted many landowners and at the very least engendered serious equity problems. Farm programs are like a drug habit, easy to start and traumatic to end. Politicians throughout the rich Western nations seem to have become addicted and one can only wonder if the present agricultural upheaval will spare them the choice between continuing the habit and the throes of withdrawal. If it is true that the remarkably high prices witnessed in the early seventies constitute a harbinger of events to come, problems of low farm prices and farm surpluses will come to be remembered as part of what will doubtless be called "the good old days."

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[20] For an excellent discussion of net willingness to pay, see [18, pp. 17–22]. The concept of producer surplus is not employed in this analysis. For a critique of producer surplus and a discussion of parallel indifference curves see [4].

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APPENDIX

Table A.1. Values of exogenous variables and farm policy parameters, 1948–70

Year	Index of Prices Paid for Operating Inputs Divided by 1957 Index (*G*)	Index of Prices Paid for Capital Divided by 1957 Index (*I*)	Land in Millions of Acres (*A*)	Nonfarm Wage Rate in Constant Dollars (*N*)	U. S. Population in Millions (*H*)	Diverted Acres in Millions	Ratio of Government Withdrawals to Farm Output (*θ*): Withdrawals Equal PL 480 Sales	Ratio of Government Withdrawals to Farm Output (*θ*): Withdrawals Equal Gross CCC Acquisitions
1948	.98	.90	359.8	1.32	146.[illegible]	0.0	.0000	.0580
1949	.92	.91	365.5	1.34	148.5	0.0	.0000	.1059
1950	.93	.90	353.2	1.45	151.[illegible]	0.0	.0000	.0683
1951	1.02	1.04	362.9	1.58	153.[illegible]	0.0	.0000	.0197
1952	1.07	1.10	356.1	1.67	156.4	0.0	.0000	.0153
1953	1.02	.98	360.5	1.76	159.0	0.0	.0000	.0713
1954	1.02	.93	354.8	1.76	161.8	0.0	.0095	.1006
1955	.99	.90	353.7	1.89	164.[illegible]	0.0	.0393	.1252
1956	.99	.96	343.4	1.96	167.5	13.6	.0599	.1050
1957	1.00	1.00	330.9	2.03	170.5	27.8	.0543	.0865
1958	1.01	1.06	325.6	2.06	173.4	27.1	.0396	.0676
1959	1.01	1.13	329.4	2.20	176.[illegible]	22.5	.0399	.1531
1960	1.02	1.11	324.5	2.24	180.0	28.7	.0471	.0845
1961	1.03	1.12	308.6	2.30	183.0	53.7	.0470	.0600
1962	1.03	1.14	299.9	2.41	185.8	64.7	.0444	.0856
1963	1.05	1.16	306.0	2.49	188.5	56.1	.0462	.0804
1964	1.05	1.15	303.3	2.57	191.2	55.5	.0511	.0659
1965	1.07	1.16	304.3	2.68	193.6	57.4	.0380	.0488
1966	1.09	1.21	297.6	2.80	195.9	63.3	.0360	.0377
1967	1.10	1.26	315.9	2.87	198.[illegible]	40.8	.0329	.0255
1968	1.11	1.32	308.1	3.06	200.[illegible]	49.3	.0328	.0226
1969	1.13	1.33	299.4	3.23	202.[illegible]	58.0	.0245	.0384
1970	1.18	1.47	300.7	3.34	204.3	57.0	.0238	.0289

Table A.2. Estimated values of endogenous variables in the absence of farm programs with PL 480 sales taken as the estimate of net government withdrawals, 1948–1970

	Endogenous Variables						
Year	Labor	Operating Inputs	Capital	Rent	Wages	Output	Price of Output
1948	17,438	7,149	5,236	$ 7.02	$ .526	24,655	.950
1949	15,936	7,448	5,109	6.99	.519	25,296	.882
1950	15,040	8,366	5,768	8.56	.565	25,542	.959
1951	15,572	9,195	6,517	10.07	.643	25,504	1.170
1952	14,353	8,995	6,454	10.96	.672	26,001	1.164
1953	13,344	9,101	6,586	10.98	.702	26,641	1.090
1954	12,574	8,887	6,649	10.86	.686	27,058	1.024
1955	11,078	8,614	6,845	10.92	.719	26,830	.988
1956	10,502	8,833	6,278	10.92	.741	26,755	.988
1957	10,159	9,237	6,810	11.87	.767	27,327	1.028
1958	9,812	9,272	6,762	12.78	.772	28,309	1.011
1959	9,483	9,880	6,764	14.50	.833	28,711	1.066
1960	9,033	9,498	6,910	15.06	.838	29,170	1.036
1961	8,629	9,532	6,754	14.17	.853	29,796	1.003
1962	8,034	9,750	6,733	14.35	.884	30,416	.988
1963	7,785	9,786	6,909	15.98	.913	30,757	1.013
1964	7,373	10,083	7,056	17.13	.934	31,045	1.022
1965	6,952	9,941	7,175	17.86	.966	31,953	1.006
1966	6,869	10,538	7,654	19.27	1.021	32,205	1.078
1967	6,725	10,050	7,493	20.92	1.047	32,729	1.069
1968	6,642	10,762	7,743	22.52	1.137	32,846	1.150
1969	6,408	10,566	7,929	23.45	1.207	33,478	1.153
1970	6,337	10,588	7,633	24.38	1.258	33,772	1.196

Table A.3. Estimated values of endogenous variables in the absence of farm programs with gross CCC purchases taken as the estimate of net government withdrawals, 1948–1970

	Endogenous Variables						
Year	Labor	Operating Inputs	Capital	Rent	Wages	Output	Price of Output
1948	16,530	6,637	4,861	$ 6.52	$ .515	23,263	.934
1949	14,430	6,489	4,451	6.09	.499	22,683	.857
1950	14,114	7,660	5,281	7.84	.551	23,844	.940
1951	15,297	8,971	6,358	9.82	.639	25,015	1.164
1952	14,156	8,824	6,332	10.75	.669	25,614	1.159
1953	12,480	8,293	6,002	10.01	.684	24,794	1.068
1954	11,524	7,873	5,891	9.63	.663	24,637	.997
1955	10,176	7,655	6,083	9.70	.696	24,498	.962
1956	10,044	8,303	5,901	10.26	.728	25,508	.974
1957	9,845	8,843	6,519	11.36	.758	26,423	1.018
1958	9,552	8,932	6,514	12.31	.764	27,508	1.002
1959	9,418	9,786	6,699	14.36	.831	28,502	1.063
1960	8,705	9,022	6,564	14.30	.826	28,061	1.023
1961	8,520	9,366	6,637	13.92	.849	29,402	.998
1962	7,715	9,217	6,364	13.57	.871	29,144	.975
1963	7,525	9,336	6,592	15.24	.901	29,689	1.002
1964	7,266	9,880	6,914	16.79	.928	30,576	1.017
1965	6,879	9,796	7,071	17.60	.962	31,606	1.002
1966	6,858	10,514	7,636	19.22	1.020	32,150	1.077
1967	6,773	10,152	7,569	21.13	1.050	32,970	1.071
1968	6,709	10,912	7,851	22.83	1.142	33,180	1.154
1969	6,321	10,366	7,780	23.01	1.201	33,018	1.147
1970	6,305	10,515	7,580	24.21	1.256	33,602	1.193

On Sources of Measured Technical Efficiency: The Impact of Information*

Jürgen Müller

The concept of technical efficiency differences—different levels of output with identical levels of input—is unsatisfactory from a production theoretic point of view. In this paper a model is developed in which differences in non-conventional inputs and especially information obtained by managers may explain productivity differences between firms. Estimation of the underlying production structure (of a sample of California dairy farms) via a modified non-homothetic Cobb-Douglas production function shows the specific impact of information within the neoclassical production framework. This is conceptually and analytically superior to the methodology of frontier production functions.

Key words: **information; technical efficiency; frontier functions; productivity.**

Central to economic theory is the concept of efficiency. Most of the relevant economic literature in this area deals with allocative inefficiency, when the marginal conditions of Pareto optimality are not met.[1] Less attention has been paid to technical inefficiency, the result of the inability of some firms to produce on the industry's production frontier.[2] Leibenstein claims that these non-allocative efficiency differences (he calls them X-efficiency) may be much more important than those due to allocative inefficiency.[3] Recent studies have tried to verify this claim empirically, concentrating on the measurement and classification of technical inefficiency, without providing a theoretical explanation for its existence.[4]

For example, one is hard pressed to explain these technical efficiency differences (i.e., different levels of output with equal inputs) using the theory of the firm and the concept of a unique, neoclassical production function.

This paper is an attempt to reanalyze the concept of technical efficiency. Starting with the concept of a unique, neoclassical production function, observed productivity differences are explained with additional inputs. Special attention is given to the role of information in this framework. An empirical application to individual firm production data substantiates the significance of information in explaining productivity differences. At the same time the concept of the "industry's production frontier" is found to be rather misleading and at best only a relative concept.

The Conceptual Framework

The problem may be illustrated by examining the unit isoquant F of a linear homogeneous production process in Figure 1, where X_1 and X_2 represent inputs and Y represents a single output.

Generally it is noted that some points in a given sample lie along a unit isoquant, while

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[1] For example, see T. W. Schultz [25], W. D. Hopper [12], and P. A. Yotopoulos [29].

[2] Leibenstein defines it as the inability of firms or economies to operate on an outer bound production possibilities surface consistent with their resources. The Lau and Yotopoulos definition is similar: "A firm is considered more technically efficient than another, if, given the same quantity of measurable inputs, it consistently produces a larger output" [18, p. 95].

[3] According to Leibenstein [20], these types of inefficiencies may exist side by side. They are at least conceptually independent of each other. One may find firms that are allocatively efficient but technically inefficient or vice versa, as well as a combination of both. Each concept can stand by itself, but one may wish to use both to evaluate the overall performance of a given firm or industry. For a more detailed discussion, see also Farrell [5].

[4] The initial works go back to Farrell [5], Nerlove [23], Bressler [3], Boles [2], Seitz [26], and Aigner and Chu [1]. Recent studies by Timmer [27] and Carlsson [4] have gone beyond the earlier measurement attempts and have tried to account for the technical differences with additional inputs or institutional and environmental factors external to the firm.

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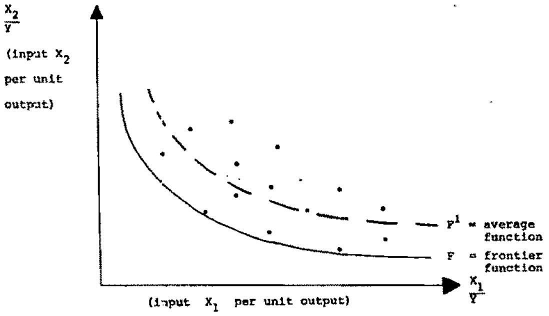

Figure 1. A cross section of individual firm's observation in input-output space

others are located away from it. An important empirical question is, "Why do all observations not lie on a single isoquant, as one would expect from production theory and optimal behavior by firms?"[5] Several answers are suggested:

(a) Production technology may differ from firm to firm;[6]

(b) Production technology does not differ between firms, but the observed differences are due to random disturbances;

(c) All firms have available the same production technology, but some are more successful than others in using it efficiently, implying real differences in technical efficiency. One would expect that these differences in efficiency are not accidental (or random), but are caused by the presence or absence of additional inputs, which affect the isoquant F.

Case (a) is not dealt with since, unless there is a comparable production structure, there is no basis for comparing relative levels among firms as it is generally defined.

Case (b) is clearly feasible and easy to deal with. The relevant isoquant is F^1, if the random disturbances are due to other factors and are of little economic consequence. The isoquant F^1 can easily be estimated by an *average* function, such as using least squares estimates and allowing for deviations on both sides of the isoquant. This is what most production function studies have generally attempted. F, which would represent the *frontier* isoquant (analogous to Leibenstein's "outer-bound production possibilities surface" [20, p. 392]), has little economic meaning in this case, since it reflects differences which are due to random disturbances only.[7]

Case (c) is obviously the more interesting and realistic one, but first one needs to spell out what these additional inputs are. They may, for example, include conventional physical inputs. Their exclusion represents a misspecification of the model, which is easily solved by adding additional dimensions to Figure 1. Of greatest interest here is the case in which all physical inputs are correctly specified. However, little is known about the role of non-physical inputs, especially information or knowledge, which influence the firm's ability to use its available technology set fully. This is similar to G. L. Johnson's [14] point that it may not be enough to specify a production function as a relation between inputs and outputs only. Knowledge of this underlying process (production or process knowledge) may also be part of the function. With respect to Figure 1, firms with better production knowledge, *ceteris paribus,* will need less of the physical input to produce a given output. These firms will be observed on or closer to the *frontier* function F in Figure 1.

This suggests how relative and artificial the concept of the *frontier* itself is. To add more of one input, i.e. production knowledge, should of course, increase output, so the frontier function can at best be defined with respect to a fixed level of information only, or for that matter, at any fixed level of other left-out factors. Once all inputs are taken into account, measured productivity differences should disappear except for random disturbances.[8] In this case the *frontier* and the *average* function are identical. They only diverge if significant inputs have been left out in the estimation.

The Factor Information

Before such a production function including information as an input can be estimated, however, the concept of information itself must be further specified, and possibilities of its quantification must be explored. It will be useful to separate the factor information into several parts. *Production* or *technical knowledge*[9] has already been mentioned. For a given technology this may be defined as input specific, i.e. as the knowledge of how inputs may be combined or processed into outputs. In addition to *production knowledge* there is also *market knowledge,* which is again product specific. It relates to information about present and future demand, the relative significance of substitutes, and the impact of advertising and promotion on a given product. Part of the information may be generated within the firm, and some may be purchased outside.[10]

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[5] See also a similar comment by Milton Friedman [6, pp. 253–281].

[6] Here I am referring to long-run differences, which cannot be overcome in the short run.

[7] For case (c), however, the frontier approach may be more useful but offers little insight into how these differences may be explained. Some studies using this frontier method were mentioned in footnote 4.

[8] Similar arguments are also found in the work by Griliches [8, 9].

[9] In the case of differentiated products, it is useful to divide *production* information into *product* information with the latter representing blue prints, patents, etc.

This rather general model may be more specifically applied to the production process of an individual firm. If one assumes that the firm produces a standardized product for which there exists a competitive market, then *market* information plays an insignificant role and may be excluded from the rest of the analysis, especially as the main concern is with the concept of technical efficiency. Therefore, the term "information" in the rest of this study deals with *production knowledge* only.

Suppose each manager accumulates production knowledge throughout his lifetime. Then, at a given point in time, he may be thought of as possessing a set of accumulated information, which he acquired perfectly rationally, according to his own cost and preference structure, and in accordance with his own abilities and experiences. This is a long-run phenomenon; in the short run, the set of information[11] will vary among managers as a function of age, experience, ability, and preference. For any given sample under investigation, the total amount of information within the sample may differ, but is constant at any point in time. It may be defined as the union of the individual firms' information sets.

This total information set, I, may also include irrelevant information which does not affect productivity. It will therefore be useful to define a *relevant* information set, I^1, where information is considered an input and profit maximization is assumed. Let I^1 be a subset of the set I. If both sets result in the same amount of profit per given inputs, *ceteris paribus,* then the set $(I - I^1)$ contains no relevant information. Choosing smaller and smaller subsets of information, one may thus choose the relevant set.[12]

At the same time there exists a technology set which describes technology.[13] It is argued here that different amounts of relevant information will affect the technology available to a given producer. This implies that for different subsets of information, different technology subsets will be known to managers. As firms acquire more information, their available technology sets will increase and their frontiers shift.[14]

Specification of a Modified Cobb-Douglas Function

How can such a model be estimated empirically? One possibility would be to quantify information and to consider it just as a conventional input X_n in a conventional production function, like the Cobb-Douglas (C.D.),[15]

$$Y_j = \prod_{i=o}^{n} X_{ij}^{a_i}, \tag{1}$$

where Y_j is the single output of the jth firm and the X_{ij}'s are the ith input of the jth firm. Let $X_{oj} = e$ the base of the natural logarithm, such that $X_{oj}^{a_o}$ represents a constant intercept and the other a_i's are the respective output elasticities for each input. The addition of the information variable should lead to a better specification and explain some of the previously unaccounted variation in output.

Sune Carlson has made me aware of this useful differentiation. By now it is obvious that the use of the concept of information in this study is different from that of information theory, as reflected, for example, in "Information Theory" by Koopmanns and Kimball [17].

[10] To what extent this division takes place depends on the market for information itself and the dynamics of the case. A more detailed theoretical analysis which looks into several of these questions and presents a more sophisticated theoretical analysis of information will be presented elsewhere.

[11] I is identified as a set (this is conceptually the most satisfactory approach). In practice, since it is difficult to measure information directly, I will be using a vector of proxy variables.

[12] This holds for a given price vector only since for different input prices, different factors of production may be used which require different sets of input specific information. However, the set could be enlarged to take account of variation in the price vector over time.

[13] I made use of a technology set rather than the usual production function, since it allowed me to assume that inefficient production choices (below the frontier) exist. This set has all the usual neoclassical properties: it is closed, non-empty, convex, and productive in the sense that increases in input levels imply the possibility of increasing output levels.

[14] This analysis may be extended to the impact of fixed capital and environmental factors on the firm's technology set. See Müller [21, Ch. 2].

[15] Cost or profit functions could not be used because of the unavailability of price data. I have also carried out some tests to see if the use of a C.D. function was justified. Using a Kmenta approximation of the CES [16], I was unable to reject the hypothesis of unitary elasticity of substitution; see Müller [21, p. 32].

However, it seems reasonable to analyze information in a role somewhat different from the rather traditional inputs, in the sense that information will affect the productivity of the other inputs in a more special way.

Using the hypothesis that information affects all other inputs uniformly, a neutral shift in the production function (such as changes in the constant term) as suggested by Mundlak and Hoch [22], allowing for shifts in the constant term only due to a non-measurable management inputs, would be an example, as would the assumption of homothetic shifts in the profit function used by Lau and Yotopoulos [19].

There is reason to believe, however, that information will produce more than just neutral shifts. For example, it may affect the productivity of one factor more than another, since, as was pointed out earlier, production knowledge may be defined as input specific. Also, one entrepreneur may have acquired more information with respect to one output rather than another. Thus, looking at the sample as a whole, combinations of neutral and non-neutral shifts seem possible. This would imply some changes in the output elasticities as well, rather than a neutral shift in the production function alone. The following modification of (1) is therefore proposed.

Let a_{ij}, the output elasticity of the jth firm with respect to the ith input, be partitioned into an overall elasticity a_i, which is the same across firms, and a firm specific deviation d_{ij}, which reflects changes in the level of available information used by the jth firm. This results in the following production function for the jth firm:

$$Y_j = \prod_{i=o}^{n} X_{ij}^{a_i + d_{ij}}. \tag{2}$$

It represents a modification of the normal C.D. production function, since the additional inputs affect the output elasticities directly, rather than being entered as separate factors of production.[16]

Several advantages need to be mentioned. The restrictive assumption that all firms in the sample possess the same output elasticities is no longer necessary. The coefficients d_{ij} $(i > 0)$ represent deviations of the firm's output elasticities from the "standard" elasticities of some average firm chosen as a basis. Therefore, they characterize the individual firm's production function and the effect of information. This formulation also covers the concept of a *frontier* function as it was discussed above. It represents those firms for which the left-out variables take on their optimal value (or highest value ignoring negative marginal products). As far as information is concerned, this would be reflected by increases in the constant term and the a_i's as compared to the average firm, for example.

There is no need to estimate a *frontier* function separately, with all its theoretical and econometric drawbacks,[17] since there only the most extreme observations are used. Here, all the observations may be used to estimate an *average* function with standard statistical tests of significance available.

Before proceeding with the estimation of (2), further difficulties have to be overcome. If a disturbance term e^{u_j} for each observation in the function, such as

$$Y = \prod_{i=o}^{n} (X_{ij}^{a_j + d_{ij}})\, e^{u_j}, \tag{3}$$

is specified, one has more parameters than observations. For example, for a cross-sectional sample of J firms with four inputs considered, $(5J) + 5$ parameters need to be estimated, since for each firm there exists a firm specific deviation for each input and the constant term plus the four "average" elasticities and the "average" constant term $X_o^{a_o}$. One solution is to recognize that the d_{ij}'s are really a function of the level of available information used by each firm. A quantification of information is, however, the most difficult part of the analysis.

Proxy Variables for Information and Their Selection

It would be worthwhile to account for information by sources of origin or such proxy variables. The data set in this study consists of a sample of California dairy farms from the San Joaquin Valley. This could involve the following variables about the managers:

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[16] This formulation is not entirely my own development. Slope shifting dummies have already been mentioned by J. Johnston [15, p. 223]. Garry Saxonhouse, in a seminar at Stanford, used a somewhat similar formulation to explain productivity changes in Japanese textile firms, where he first estimated the elasticities and then correlated them with additional (non-conventional) inputs. In an unpublished thesis Q. Paris [24], using the same data sources, proposes a firm specific production function in which the output elasticities for each firm are composed of input specific elasticities, a firm specific deviation for all elasticities combined plus a time trend; the last two are introduced as dummy variables and tested for their significance. The main difference here is that I use firm specific deviations for each input based on the level of information each firm has, rather than a general dummy variable.

[17] See J. Müller [21, Chps. 3 and 4] for details.

(a) amount of education (indicating some acquired information, but mainly the ability to use external information);[18]
(b) age and experience as proxies for learning by doing (indicating mainly accumulated knowledge);
(c) current inflow of information (indicating the use of external knowledge).

Actually, the sample contains only data on (c), namely expenditures for consulting by the Dairy Herd Improvement Association (DHIA) and expenditures for veterinary medicine. In addition one must therefore use what can be called "revealed information" proxies, which are also contained in the data.

If information affects the production process as earlier postulated, then it should also be reflected in the actual operation of the firm. For example, it is assumed that farmers with more information are better herd managers. They are more efficient in using their capital stock of cows, i.e. they are more successful in having their cows calve in regular, short intervals. This keeps feed, labor, and cow service flow input per unit of output lower than it otherwise would be. Thus, the ratio of cows milking to cows dry (defined as fertility index) may reflect or reveal a higher level of information.[19] Several similar variables have been collected by the Bureau of Milk Stabilization.

Let Z_{kj} be the kth proxy information variable of the jth firm. It is proposed that the Z_{kj}'s are a function of the amount of information present:

$$\begin{aligned} Z_j &= (Z_{kj}) \qquad \text{for} \qquad k = 1, \ldots, K \\ &= h(I_j). \end{aligned}$$

Also note the formal link with sources of information,

$$I_j = p(S_{mj}) \qquad \text{for} \qquad m = 1, \ldots, M,$$

where S_{mj} is the amount of the mth information source used by the jth farmer. Returning to the production function,

$$(4) \qquad Y_j = \prod_{i=o}^{n} (X_{ij}^{a_i+d_{ij}})\, e^{u_j},$$

it is now necessary to specify how the proxy variables for information are related to the d_{ij}'s. The following relationship is postulated:

$$d_{ij} = \sum_{k=1}^{K} b_{ik} Z_{kj} \qquad \text{for all inputs } i.$$

This may be substituted into the production function

$$(5) \qquad Y_j = \prod_{i=o}^{n} (X_{ij}^{a_i+\sum_{k=1}^{K} b_{ik}Z_{kj}})\, e^{u_j}.$$

The kth information proxy may represent different effects on each input (i.e., input specific information). If this holds for all inputs, equation (5) cannot be estimated, given the limited size of the sample. There is a logical simplification, however. Not all Z_k's will affect all output elasticities significantly; for some the coefficient b_{ik} may be close to zero. Others may be expected to affect the function only neutrally, thus just entering in the constant term. In addition, if they are closely correlated among themselves, some may be used as proxies for others. To select a limited number of proxy variables for information, the author has chosen a slightly indirect way, namely, to test their statistical significance in the framework of a somewhat different methodology.

One can estimate the level of technical inefficiency using *frontier* functions, as mentioned above, by fitting an envelope to the observations in input-output-space, using an LP algorithm. If this observed technical inefficiency, i.e. the difference between the envelope and the observation, is largely due to differences in available information used by a given firm, as postulated, then the Z_k's should also explain these residuals or what can be called efficiency differences, even though they may contain random disturbances. Three variables which had a high explanatory power were thus selected for the estimation of equation (5): *DH, FY,* and *LP*.[20, 21]

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[18] This concept, along with current inflow of information, has also been used by Wallace Huffman [13] in his recent paper "Decision Making: The Role of Education."

[19] The author acknowledges that this type of analysis may contain some circular reasoning. However, given the data limitation, such variables may be of some use in supplementing the other information proxies available.

[20] These results along with the problems of frontier functions in general are discussed at length in Müller [21, Chps. 3 and 4]. Generally, the coefficients of the *frontier* function estimates are biased, as no information variables were included in the initial estimation. The bias results from this type of two-step regression, since the left-out variables (information) in the first step are correlated with the other inputs. For a detailed proof, see Goldberger [7, p. 195]. Nevertheless, this procedure was sufficient to identify some proxy variables for information. Another possibility would be factor analysis or the analysis of principal components.

[21] *DH* = the level of fees paid to the Dairy Herd Improvement Association, a trade organization which distributed production information to members and collected production data in relation to herd management. These services were available at different costs and levels

Estimation of the Modified Function

These three variables may now be used in the estimation of equation (5).[22] Several estimations on the 1964 sample indicated that not all of the three information proxies would affect all output elasticities significantly. Some of them could be dropped, yielding the following functional form:

$$(6)\quad Y = X_o^{a_o + b_{o1}DH + b_{o2}FY} FD^{a_1 + b_{11}DH} LB^{a_2 + b_{21}LP} C^{a_3} OC^{a_4 + b_{41}DH}$$

or in log-linear form:

$$(7)\quad \log Y = (a_o + b_{o1}DH + b_{o2}FY) \log X_o + (a_1 + b_{11}DH) \log FD + (a_2 + b_{21}LP) \log LB + a_3 \log C + (a_4 + b_{41}DH) \log OC,$$

where

$X_o = e$, the base of the natural logarithm,
DH = fees for the DHIA,
FY = fertility index,
LP = *CBMS* management index,
FD = feed in *TDN* (total digestible nutrient),
LB = labor in man months,
C = capital, representing a service flow (rather than a stock) variable which accounts for variable capital (cows) and fixed capital,

and

OC = current operating inputs.[23]

This equation was estimated in the log-linear form on the 1964 sample, using least squares. The results are reported in Table 1.

There is a common intercept for all firms, a_o, plus a neutral shift for each firm, depending on the level of FY and DH. The FY and the DH coefficients are significant and positive at the 99.9 percent and 90 percent levels of significance, respectively. This supports the earlier hypothesis that there are neutral shifts in the production function across firms which can be explained by different levels of information.

The size of the average intercept $(a_o + b_{o1} DH + b_{o2} FY) \log X_o$ has been calculated as 3.79, where the average levels of DH and FY are used for the calculation.[24] Estimates of shifts in the intercept of the function are as expected on theoretical grounds, namely that more information would shift the function upward neutrally, resulting in a larger output for given inputs. With respect to the elasticity shifters, one would expect that higher levels of information would produce a positive coefficient as well. This is not the case with all elasticity shifters. In the case of feed, for example, DH has a significant (at the 90 percent level) negative effect, and with respect to current operating inputs, a positive but statistically insignificant effect.

Does this mean that information provided to the farmers by the DHIA has a negative effect on productivity of feed? To answer this question, the total effect of DHIA, i.e., the positive, neutral shift in the entire function and the negative input specific effect must be considered. Combined, their total effect may be positive or negative.

The impact of DHIA as specified in (6) and then its specific effect on feed productivity are analyzed by evaluating the marginal physical product of feed. Differentiating (7) with respect to DH yields

$$\frac{\partial \log Y}{\partial DH} = b_{o1} \log X_o + b_{11} \log FD + b_{41} \log OC.$$

Evaluating this at the average value of the variables FD and OC[25] implies that the total effect is indeed positive.

The specific effect of information on the feed input may be represented by

$$\frac{\partial Y}{\partial FD} = (a_1 + b_{11}\, DH)\; Y/FD.$$

For the average DHIA member, the total output elasticity decreases from .764 to .692, thereby lowering his marginal physical product of feed.[26] At the same time the neutral shift in the function for the DHIA member raises the expression by 1.552 (i.e., $e^{b_1 DH} = e^{0.44}$). This outweighs the

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of intensity. FY = the fertility index representing a revealed information type variable, indicating levels of herd management. LP = the CBMS (California Bureau of Milk Stabilization) Management index, based on a performance evaluation of managers by CBMS interviewers. The criteria seemed to be related to their relative production costs.

[22] I justify the single estimation with Hoch's [11] assumption that farmers maximize anticipated, rather than actual output.

[23] A detailed description of how the inputs are defined and aggregated is found in Müller [21].

[24] $\log A = 3.22 + DHI\,(.0113) + FY\,(.0231) = 3.22 + 38.92\,(.0113) + 5.707\,(.0231) = 3.79.$

[25] The average value for 1964 of $\log FD = 8.07$ and $\log OC = 6.17$.

[26] The decrease in the output elasticity is

$$.764 - .00187\,(38.92) = .692$$

Table 1. Coefficients of the modified average function[a]

Variables		1964 Sample	1960–63 Sample
Constant (in logs)	a_o	3.22	2.87
		(.55)	(.32)
DHIA	b_{o1}	1.13×10^{-2}	1.58×10^{-2}
		(8.6×10^{-3})	(2.3×10^{-3})
Fertility	b_{o2}	2.31×10^{-2}	1.03×10^{-2}
		(.0011)	(3.9×10^{-4})
Total Intercept[b]	$a_o + b_{o1}DH + b_{o2}FY$	3.79	2.94
Feed	a_1	.764	.725
		(.087)	(.069)
ln Feed · *DH*	b_{11}	-1.37×10^{-3}	-1.57×10^{-3}
		(1.7×10^{-3})	(2.5×10^{-4})
Total Feed[b]	$a_1 + b_{11}DH$	.692	.673
Labor	a_2	.162	.127
		(.065)	(.05)
ln Labor · *LP*	b_{21}	4.21×10^{-5}	5.65×10^{-5}
		(1.1×10^{-5})	(7.1×10^{-6})
Total Labor[b]	$a_2 + b_{21}LP$	.188	.161
Capital	a_3	.081	.124
		(.09)	(.056)
Current Operating Inputs	a_4	-8.7×10^{-3}	.037
		(9.7×10^{-3})	(.04)
ln *OC* · *DH*	b_{41}	6.26×10^{-4}	6.73×10^{-4}
		(2.1×10^{-3})	(1.3×10^{-3})
Total *OC*[b]	$a_4 + b_{41}DH$	.016	.059
1961		—	−.0836
			(.033)
1962		—	−.0742
			(.029)
1963		—	−.0558
			(.029)
R^2		.9853	.9903
n		39	152
Σa_i[c]		.977	1.017

[a] Standard errors are given in parentheses.

[b] The calculated total values of the output elasticities and the intercept were calculated using average levels of *DHI, FY,* and *LP,* respectively.

[c] This is the sum of the modified output elasticities evaluated at the average levels of *DHIA, FY,* and *LP,* respectively.

earlier negative shift and thus provides for an overall positive effect on the productivity of feed.[27]

With respect to other inputs, where there is no decline in the output elasticity, the increase in productivity due to the information proxy DHIA is, of course, larger. This means that information provided by the DHIA has a smaller effect on the productivity of feed than on the other inputs, most likely because there are so many other agencies and institutions which provide already for a rather high level of information with respect to efficient feeding programs. This would tend to reduce the possible impact of DHIA programs in that area.

The other output elasticities may be interpreted in a similar way. In light of these estimates of the modified C.D. function on the initial 1964 sample, it seems that a reasonable production structure has been identified in the sense that it fits the theoretical model and results in statistically significant parameters. This production function was further tested on an enlarged sample, using the 1960–1963 data set. These results are also reported in Table 1. They are similar to the 1964 estimates except for a decrease in the standard errors of some of the estimated coefficients.[28] This may be due to the larger sample size, where extreme observations have proportionately less weight, and to the introduction of dummy variables for the years 1961, 1962, and 1963. These are thought to account for any neutral shifts in the function due to additional effects, such as weather, which have not been measured. The coefficients indicate a significant upward trend in the overall productivity.[29]

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[27] As one of the reviewers noted, this holds only at the average input level. With high enough feed inputs the total effect must become negative. However, this does not happen over the data range for which the function was fitted.

The other coefficients may be interpreted like the 1964 results. They suggest that information is indeed a significant input and its inclusion in the production function estimation reduces the observed productivity differences. This is mainly because of the effect of information on the function's parameters, which allows the individual firm's function to deviate from the traditional average function. Thus with the estimated parameters, each firm's production function can now be calculated. It represents the firm's available technology set on its *frontier* function for a given level of information.

It is also interesting to note that even though the estimated function was unconstrained, there is no significant economy of scale effect for the sample as a whole, justifying the earlier theoretical specifications. For specific firms, however, this type of function may exhibit increasing returns to scale if the level of information is sufficiently large. This also illustrates the point that because of the effect of information on the function's parameters, the individual firm's function may deviate from the traditional *average* function.

These deviations, based on different levels of information, result in increasing returns to scale for the firm close to the *frontier,* as compared to the *average* firm for which no significant increasing returns to scale were observed. A casual inspection of the sum of the elasticities, when the information variables DH and LP are set at zero, yields a higher sum, however, resulting in 1.006 vs. .977 and 1.035 vs. 1.006. This indicates a drop in the elasticity sum that stems from the information variables.

This apparent drop is caused by the negative feed coefficient b_{11}. What really must be analyzed, however, is the sum of the elasticities for each firm when their respective information values are taken into account, since they were not set at zero during the estimation. The subsequent sums do indeed vary significantly, and increasing returns to scale correlate well with the technical efficiency measurement obtained in the frontier estimation mentioned earlier.

This interpretation suggests that the neoclassical concept of the production function is perfectly able to account for technical efficiency differences, which was not possible before, given that significant inputs and outputs are correctly accounted for. Firms at the industry frontier have available some additional inputs which make them seem more technically efficient while, if the production function is interpreted correctly, they are not. Therefore, any attempt to estimate technical inefficiency via a frontier function can at best be only a first step to identify the additional inputs which cause the efficiency differences. In themselves they have little meaning since they fail to specify how the additional inputs affect the technology set. They may only lead us away from the source of the problem, namely to identify the importance and magnitude of these additional inputs and to analyze to what extent and why they may have been allocated inefficiently.

There is another implication from the empirical results. The continuous increase in overall productivity for the years observed suggests something about the dynamics of the role of information. An increase in available information over time may be reflected. This means that the available technology set also shifts outward continuously, making the manager's potential to use available information an important variable in a dynamic sense. There seems to be a continuous adjustment process taking place, the dynamic implication of which will have to be analyzed elsewhere.

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[28] These estimates may be subject to serial correlation, since I have pooled the cross section data for four years. We have not attempted to deal with this problem, since the estimates, although inefficient, are unbiased.

[29] For this larger sample I could also have used 38 firm specific dummies (in a covariance analysis as suggested by Mundlak and Hoch) to account for innate ability of the entrepreneurs plus other firm specific characteristics which I have not been able to measure. However, given the large R^2, I have not tried this approach.

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A Model of the U. S. Apple Industry: A Quadratic Interregional Intertemporal Activity Analysis Formulation*

HILARIUS W. FUCHS, RAYMOND O. P. FARRISH, AND ROBERT W. BOHALL

An in-depth analysis of the U. S. apple industry and its problems requires simultaneous consideration of its multiple dimensions of space, time, resources, commodities, production activities, and marketing levels. An empirical model incorporating these dimensions is constructed and its use for policy analysis is demonstrated by measuring the impact of alternative size reductions in regional apple marketings on f.o.b. level industry and regional net returns. The model could also be used in determining the ramifications of changes in consumer demand, transportation costs, and marketing margins on such factors as production, prices, and interregional flows.

Key words: **apples; spatial; temporal; interregional; model; returns.**

THIS STUDY PRESENTS a mathematical model of the U. S. apple industry which can be used as a research or policy tool to ascertain the quantitative impact of changes in factors such as industry supply conditions, consumer demand, marketing margins, and labor costs on other factors such as producer incomes, interregional and intertemporal product flows, consumption patterns, and price levels. The model simultaneously includes multiple dimensions of space, time, resources, commodities, and production and marketing levels. A search of the literature reveals this to be the first empirical attempt of this nature, although a number of studies have incorporated some of these dimensions in studying other agricultural industries (e.g. [5, 6, 7, 8]).

A model such as this could be beneficial in understanding and analyzing the U. S. apple industry and some of its current problems, as evidenced by recent trends. Commercial apple production increased by 1,492.4 million pounds or 31.8 percent between the periods 1950–59 and 1968–71 [15]. This increase has occurred despite sizable reductions in the number of bearing age trees (e.g., 39.5 million in 1950 vs. 22.7 million in 1969 [13]). Per capita consumption of fresh apples and apple products actually declined slightly between 1950–59 and 1968–71 from 27.7 to 27.1 pounds (fresh weight equivalent), respectively [16]. U. S. exports of apples have declined in recent years, aggravating the supply-demand situation.

The relatively lower apple product prices resulting from these trends, coupled with increased production costs, have led to marketing and income difficulties despite increases in productivity. This, together with probable economies of scale, has contributed to the 61 percent decline in farms producing apples between 1964 and 1969 [13]. Recent concern for the industry's problems is exemplified by the Secretary of Agriculture's announcement in January 1972 establishing a special apple marketing team to ". . . marshall the Nation's 'expertise' to improve farm prices and net farm income" [18].

The Model

The continental U. S. was divided into nine contiguous consumption regions (designated by j), only six of which were commercial apple producers (designated by i). Each region was represented by a city approximating major concentrations of apple production and/or consumption within the region (Fig. 1). Since apple harvesting operations are concentrated in the time period September through November, fresh apple consumption occurring in late spring and summer must come from refrigerated storage or small quantities harvested in late summer. Of the two available types of storage, regular atmo-

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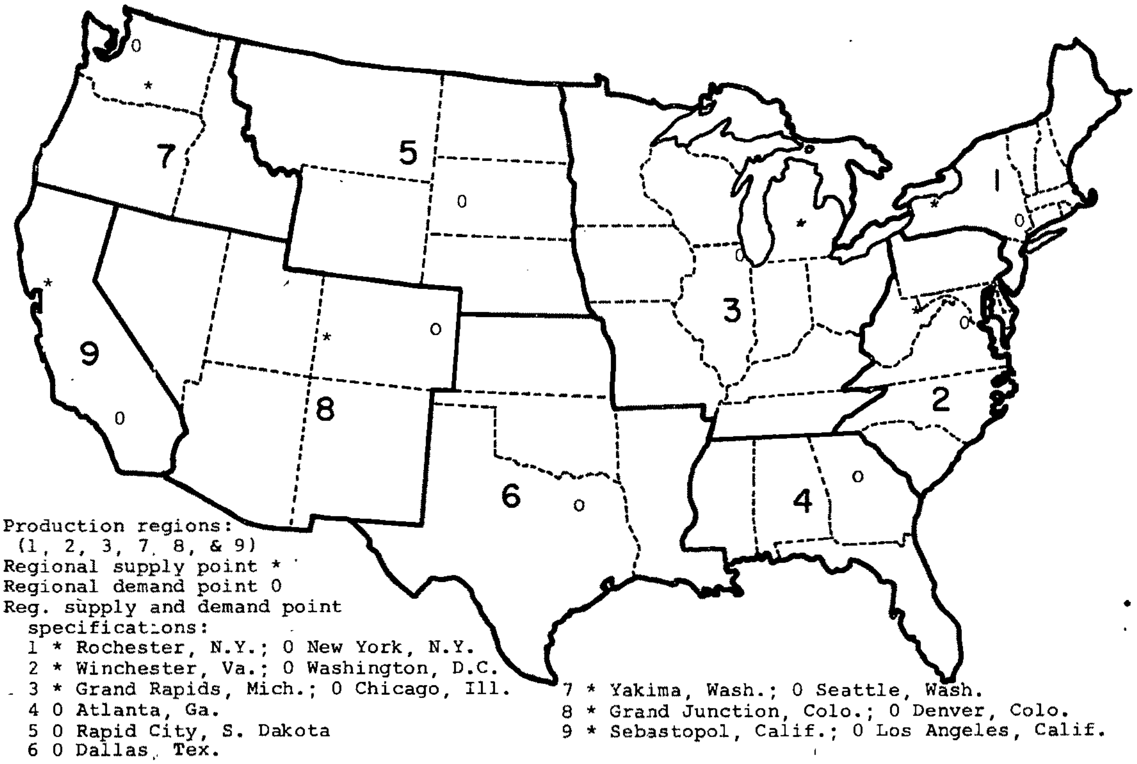

Production regions:
(1, 2, 3, 7, 8, & 9)
Regional supply point *
Regional demand point 0
Reg. supply and demand point specifications:
1 * Rochester, N.Y.; 0 New York, N.Y.
2 * Winchester, Va.; 0 Washington, D.C.
3 * Grand Rapids, Mich.; 0 Chicago, Ill.
4 0 Atlanta, Ga.
5 0 Rapid City, S. Dakota
6 0 Dallas, Tex.
7 * Yakima, Wash.; 0 Seattle, Wash.
8 * Grand Junction, Colo.; 0 Denver, Colo.
9 * Sebastopol, Calif.; 0 Los Angeles, Calif.

Figure 1. Apple industry model regional delineation of the continental United States including specification of demand and supply points

sphere (RA) and controlled atmosphere (CA),[1] CA storage is the only feasible means to store apples into the summer months. The time horizon is the 1969/70 crop year which is divided into two time periods: the first (September-March), associated with harvesting apples and RA storage, and the second (April-August), with CA storage. To keep the programming problem down to manageable size, RA storage was not entered into the model as a separate time period. Further development of the model would certainly call for the inclusion of RA storage activities.

The U. S. apple industry is characterized by a multi-product and multi-resource framework. Besides being eaten fresh, apples are used in processed products such as applesauce, pies, juices, cider, wines, jellies, jams, apple butter, and dried apples. However, only fresh apples and applesauce are considered in the model because data were available for their inclusion.[2] The primary resources in the model are 1969/70 season regional quantities of apples "on the tree" prior to harvesting operations. The on-tree apples are of three types: fresh, dual purpose, and processing. "Fresh" are those varieties most often eaten in their original form, while "processing" varieties are those intended for marketing in a processed form. "Dual purpose" apples lend to either fresh or processed product use.

The production and marketing functions required to transform on-tree apples into retail products are also included in the model. These operations are: (1) harvesting on-tree apple supplies; (2) CA storage of harvested apples from time period one to two; (3) packing and processing harvested or stored apples into fresh packed apples or applesauce (packed apples are produced from fresh and dual purpose apples and utilities);[3] (4) storage of canned applesauce in warehouses from period one to two; (5) transportation of packed apples and applesauce (referred to as f.o.b. level products) from the production regions to any of the nine consumption regions; and (6) wholesale and retail distribution of the products to the final consumer. (Refer to the schematic diagram in Fig. 2.)

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[1] Unlike RA storage, CA storage involves not only reducing the air temperature but also strict regulation of the carbon dioxide and oxygen content of the air in order to prevent respiration of the apples and thus their breakdown in quality. The CA operations are about twice as costly but allow much longer periods of apple storage.

[2] Applesauce is the predominant processed apple product, representing nearly half of all processed apple product per capita consumption during the 1969/70 crop season.

[3] Utilities (including culls) are apples rejected during fresh packing operations due to inadequate quality or size. Utilities are sold to processing firms to produce processed products.

In addition to the foregoing, the model assumes the following:

(a) Homogeneity within each resource, intermediate and final commodity categorization;

(b) No apple production costs prior to harvesting operations are included in the model since at the time of harvest these are "sunk" costs. The producer will harvest his apples to maximize returns or minimize losses as long as the price he receives covers harvesting costs;

(c) Apple packing and applesauce processing facilities are not an effective constraint on production. Regional technical production coefficients and costs are independent of the level of production;

(d) Capacity constraints are placed on regional CA storage facilities but not on applesauce warehouse space. Storage costs and CA storage loss coefficients are independent of storage levels. Canned applesauce is assumed to have zero loss during storage;

(e) Shipping, wholesaling, and retailing costs are aggregated into a per unit cost which is independent of the quantity shipped and marketed. No cost is attributed to intraregional shipments. Transportation charges are those for the most commonly used form of transport (i.e., rail or truck) between each production and consumption point. A 4 percent loss of fresh packed apples is assumed during transportation and marketing activities while none is assumed for applesauce. Also, no limit on the availability of rail and truck service is assumed; and

(f) No foreign exports or imports of apples or applesauce are considered. During the 1969/70 crop year U. S. exports and im-

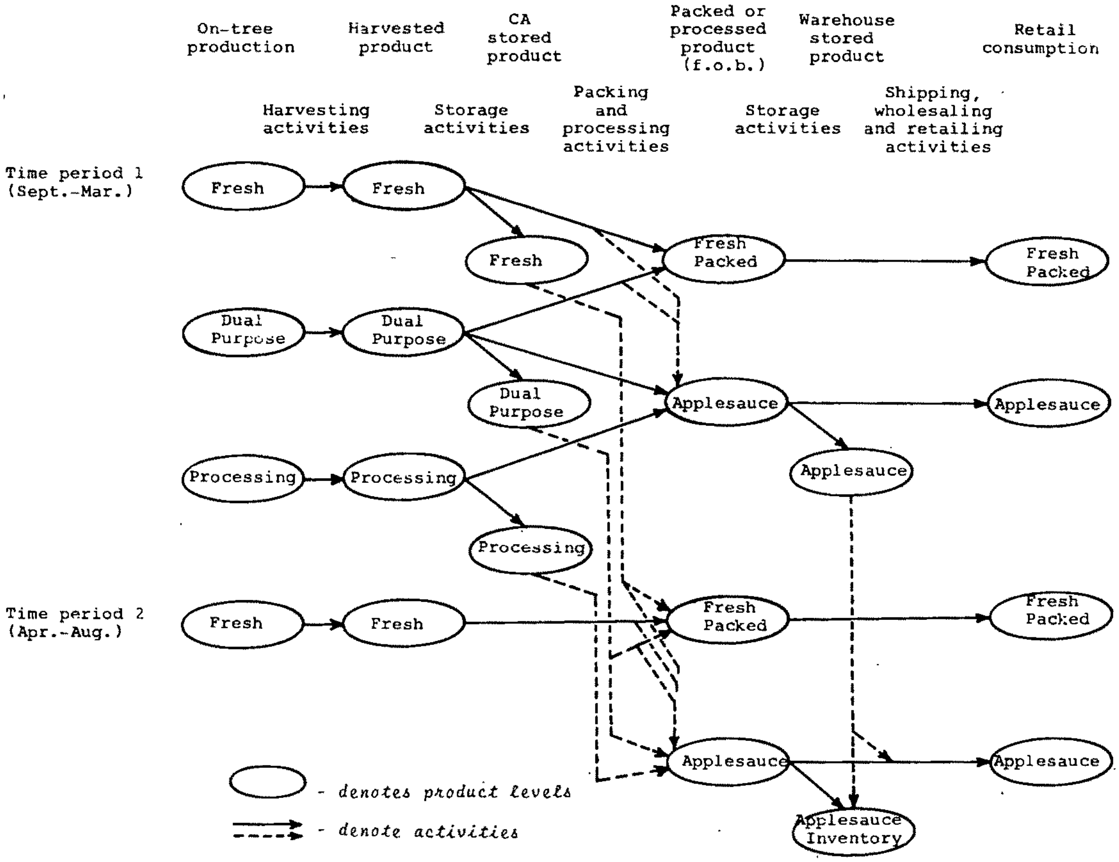

Figure 2. Schematic diagram of U. S. apple industry model

ports were nearly offsetting and each represented less than 2 percent of total U. S. production.

Mathematical formulation of the model

The model formulation follows that of Takayama and Judge [11, Chps. 14 and 17]. This formulation consists of maximizing a concave quadratic objective function subject to a set of linear, inequality constraints and non-negativity conditions. The constraints describe the production, storage, transshipment, marketing, and capacity restrictions consistent with the industry being examined. The objective function consists of the line integral[4] of linear price dependent final commodity demand functions minus the total cost of producing, processing, storing, transporting, and marketing the industry's goods. There are separate demand functions for each product, in each region, and during each time period; the demand functions are required to have symmetric cross-quantity coefficients.[5]

The Kuhn-Tucker conditions for a unique optimal solution to this formulation provide competitive equilibrium conditions[6] at all production and marketing levels within the industry. Although noncompetitive elements certainly exist in the apple industry, most noticeably in the processing sector, competition is more nearly the norm, as evidenced by the conclusions of studies by Drew [1], Greig [4], and Evans [2].

Objective function.—The objective function to be maximized takes the following form:

$$\sum_j \sum_t \sum_r \sigma^{t-1} \int (p_j^{rt}) dy_j^{rt} - \sigma^{t-1} CX \tag{1}$$

where:

p_j^{rt} = a linear price dependent demand function for retail commodity r (fresh apples or applesauce) during time period t in consumption region j. Each demand function contains an independent quantity variable for fresh apples and applesauce;

y_j^{rt} = the quantity consumed of retail product r during time period t in consumption region j;

σ^{t-1} = term to discount period two values to that of period one;

C = vector of per unit harvesting, processing (packing), storing, shipping, and marketing costs;

and

X = vector of harvesting, processing (packing), storing, shipping, and marketing activities.

Constraint set.—The model is constrained by 129 linear inequalities and 353 non-negativity conditions (one for each structural variable). The following gives the equational form of each type of constraint and a brief interpretation.

Harvesting on-tree apples[7]

Equation (2) provides for the picking of apples from trees and hauling operations necessary to transport them to the packing house, processing plant, or storage facility.

$$s_i^{et} \geqslant a_i^{eht} x_i^{ht}. \tag{2}$$

The variable s_i^{et} is the predetermined on-tree quantity of apple type e [$e = 1$ (fresh), $e = 2$ (dual purpose), and $e = 3$ (processing)] in each region i and time period t; this must be greater than or equal to the quantity of e harvested, x_i^{ht}, multiplied by a technical coefficient describing the amount of on-tree apple type e required to produce a unit of harvested product h, a_i^{eht}. Harvested apples have the same use categories as on-tree apples where: $h = 1$ (fresh); $h = 2$ (dual purpose); and $h = 3$ (processing).

Packing, processing, and storage of harvested apples

Equations (3.1) and (3.2) provide for the packing of fresh apples and processing apples into applesauce and the possibility of storing harvested apples for use in time period two. These equations take on different forms depending on the time period and use category of harvested apples. They are as follows:

---

[4] Note that the integral is a line integral, not a simple multiple integral. For a discussion of line integration see [10, pp. 405–410].

[5] This is the integrability condition which is necessary to line integrate the objective function in order to derive the quasi-welfare function that will provide the appropriate equilibrium conditions.

[6] The equilibrium is partial since only a small subset of the U. S. economy is being modeled. Thus, *ceteris paribus* is assumed for prices and income associated with all other goods and services in the economy.

[7] Some production regions do not produce every category of on-tree apples, and only fresh variety apples are harvested in time period two. All fresh apple quantities are expressed in millions of pounds and applesauce in millions of sized 303 (i.e., one pound) cans.

Time period one[8]

$$(3.1) \qquad x_i^{h1} \geqslant \sum_m a_i^{hm1}\, x_i^{m1} + x_{i1}{}^{h}{}_{1,2}$$

Time period two

$$(3.2) \qquad x_i^{h2} + a_{i1}{}^{h}{}_{1,2}\, x_{i1}{}^{h}{}_{1,2} \geqslant \sum_m a_i^{hm2}\, x_i^{m2}$$

when $h = 1$ (fresh), then $m = 1$ (fresh packed apples)
when $h = 2$ (dual purpose), then $m = 2$ (fresh packed apples)
and $m = 3$ (canned applesauce)
when $h = 3$ (processing), then $m = 4$ (canned applesauce).

Equation (3.1) states that the quantity of type h apples harvested in region i during time period one, x_i^{h1}, must be greater than or equal to: (a) the quantity of f.o.b. level products produced from type h apples in region i during period one, x_i^{m1}, multiplied by a technical factor, a_i^{hm1}, indicating the amount of harvested level product h required to produce one unit of f.o.b. level product m; plus (b) the amount of harvested product h stored in facility one (CA storage) from time period one to two, $x_{i1}{}^{h}{}_{1,2}$. In the case of harvested dual purpose apples, $h = 2$, product substitution between fresh apples, $m = 2$, and applesauce, $m = 3$, is possible depending on the relative strengths of the derived demands for these f.o.b. level products.

Equation (3.2) is essentially the same as equation (3.1) except that (a) there is no storage out of time period two; and (b) a carry-in is specified equal to the amount of apples stored in the first time period multiplied by a factor indicating the proportion of apples not lost during storage operations, $a_{i1}{}^{h}{}_{1,2}$.

During fresh packing operations, utility apples are graded out and sent to processing plants for making processed apple products. Equation (3.3) specifies that the quantity of utility apples available in region i during time period t (determined as some proportion, b_i^{hmt}, of fresh apples packed, x_i^{mt}) must be greater than or equal to the quantity of applesauce produced from utility apples, x_i^{5t}, multiplied by the product transformation coefficient a_i^{h5t}.[9]

$$(3.3) \qquad \sum_{m=1}^{2} b_i^{hmt}\, x_i^{mt} \geqslant a_i^{h5t}\, x_i^{5t}$$

where

$$b_i^{hmt} = a_i^{hmt} - 1.$$

Since no processed apple products other than applesauce are taken into account in the model, harvested and utility apples which would normally go into producing processed products other than applesauce had to be ejected from the model. The method chosen was to adjust the estimated applesauce transformation coefficients, a_i^{hmt}, by the 1969/70 season average proportion of apples going into applesauce production out of all apples going to processing uses.

Applesauce storage and shipment of f.o.b products to final demand regions

Equations (4.1) and (4.2) allow for storage of canned applesauce in warehouses and intraregional and interregional shipments of fresh packed apples and canned applesauce. These equations differ as to time period and commodity.

Time period one

$$(4.1) \qquad \sum_m x_i^{m1} \geqslant \sum_j a_i^{fr1}\, x_{ij}^{r1} + x_{i2}{}^{2}{}_{1,2}$$

Time period two

$$(4.2) \qquad \sum_m x_i^{m2} + x_{i2}{}^{2}{}_{1,2} \geqslant \sum_j a_i^{fr2}\, x_{ij}^{r2} + x_{i2}{}^{2}{}_{2,3}$$

when $f = 1$ (fresh packed apples), then $m = 1,2$;
$f = 2$ (applesauce), then $m = 3,4,5$.

Equation (4.1) specifies that in period one, the total quantity of an f.o.b. level product available, $\sum\limits_m x_i^{m1}$, must be greater than or equal to intraregional ($i = j$) and interregional ($i \neq j$) shipments from production region i to each consumption region j, $\sum\limits_j x_{ij}^{r1}$, with a factor, a_i^{fr1}, adjusting product movements for losses during transshipment and marketing activities. The term $x_{i\theta}{}^{f}{}_{1,2}$ (where $\theta = 2$ and $f = 2$) denotes storage into time period two and applies only to warehouse storage of applesauce since no f.o.b. level fresh apple storage is assumed.

Equation (4.2) differs from (4.1) in the case of applesauce since there is a carry-in of stored quantities of applesauce into time period two, $x_{i2}{}^{2}{}_{1,2}$ (no storage loss of applesauce is assumed, thus $a_{i2}{}^{2}{}_{1,2} = 1$). Also, there is an applesauce carry-out from period two, $x_{i2}{}^{2}{}_{2,3}$, associated with *a priori* applesauce inventory levels.

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[8] The notation $x_{i\theta}{}^{v}{}_{t,t+1}$ allows for more than one storage function, i.e., $\theta = 1,2, \ldots, n$. Our model considers CA storage of harvested apples, $\theta = 1$, at the harvesting level ($v = h$) and warehouse storage of applesauce, $\theta = 2$, at the f.o.b. marketing level ($v = f$).

[9] The superscript $m = 5$ represents canned applesauce produced from utility apples rejected during fresh packing activities for fresh ($m = 1$) and dual purpose ($m = 2$) apples.

Applesauce inventory

The crop year to crop year change in applesauce inventory is normally small, but the 1969/70 season resulted in a record crop and consequently large applesauce inventories and carryover into the 1970/71 season (a net increase of 62.743 million size 303 cans).

$$s^{22} = \sum_{i} x_{i2}^{2}{}_{2,3} \tag{5}$$

Equation (5) requires that the summation of all regional applesauce carry-out activities from period two, $\sum_{i} x_{i2}^{2}{}_{2,3}$, be exactly equal to this U. S. inventory buildup, s^{ft} ($f = 2$ and $t = 2$). Data was lacking for a regional specification of inventories.

Final consumption

$$\sum_{i} x_{ij}^{rt} \geqslant y_{j}^{rt} \tag{6}$$

Equation (6) requires that the accumulation of intraregional and interregional shipments of product r (fresh apples or applesauce) from each of the production regions i into consumption region j during time period t, $\sum_{i} x_{ij}^{rt}$, be greater than or equal to total retail consumption of product r in region j during period t, y_{j}^{rt}. In other words, the total regional supply of fresh packed apples (applesauce) during a time period, must be at least equal to the quantity of each product consumed.

Storage capacity restrictions

Equation (7) insures that regional CA storage capacity is not exceeded.

$$\sum_{h} s_{i}^{h1} \geqslant \sum_{h} x_{i1}^{h}{}_{1,2} \tag{7}$$

The total CA storage capacity for all categories of harvested apples, h, in region i during time period one, $\sum_{h} s_{i}^{h1}$, must be greater than or equal to the total quantity of harvested apples stored in region i between time periods one and two, $\sum_{h} x_{i1}^{h}{}_{1,2}$. There are no capacity constraints for applesauce warehouse space.

Non-negativity conditions

$$x_{i}^{ut},\ x_{ij}^{rt},\ x_{i\theta}^{v}{}_{t,t+1} \geqslant 0 \tag{8}$$

where

$$u = e, h \text{ and } v = h, f.$$

Statement (8) merely requires all variables in the model to be greater than or equal to zero.

Data Estimates[10]

Data estimates for the empirical model required special surveys and numerous other primary and secondary sources. Regional harvesting, storing, production, and processing technical coefficients and costs were derived from a 1969/70 survey of the major U. S. apple production areas conducted by the Marketing Economics Division, Economic Research Service, USDA [9]. On-tree quantities of fresh, dual purpose, and processing apples were computed from Statistical Reporting Service estimates of varietal crop sizes by state. The varieties were categorized as fresh, dual purpose, and processing based upon information obtained from the Plant Science Department, University of Connecticut.[11] Regional CA storage capacities were assumed to be the maximum of regional CA apple storage holdings during the 1967/68–1969/70 crop seasons as reported by the International Apple Institute.

USDA reports of fresh apple unloads and the 1967 *Census of Transportation* [14] were used to determine the most common carrier (i.e., rail or truck) of apples and applesauce between each of the production and consumption points. Transportation costs were obtained from the Agricultural Stabilization and Conservation Service of the USDA and a telephone survey of shippers and truck brokers.

Regional wholesale and retail marketing margins were developed by estimating wholesale-retail margins as a function of retail prices for cities in which data were available, and then using Bureau of Labor benchmark retail prices for representative cities in each region of the model to estimate the necessary regional wholesale-retail margins.[12]

Regional and temporal demand equations were estimated from U. S. average per capita relations by applying appropriate regional population and income statistics. Restricted least squares estimates of U. S. average per capita retail consumption[13] were calculated from seasonal time series data for the crop years 1963/64–1969/70, inclusive. The independent variables in the fresh equation were retail prices for fresh apples and applesauce including per capita disposable income; those in the applesauce equation included the retail prices plus dummy seasonal variables and a trend variable. Seasonal, trend, regional disposable income, and population estimates for the 1969/70 crop year were placed into these estimated relations and consolidated into the constant terms (thus leaving the two independent price variables). An inversion of the regional and temporal demand equations placed the relations in the price dependent form required by the model formulation. The empirical data are presented in Tables 1, 2, and 3.

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[10] A complete listing of data sources and calculations performed can be found in [3].

[11] Special thanks are due Mr. David Kollas, Extension Specialist in Pomology, for providing information on which to base the categorization.

[12] Monthly data for the 1969/70 crop season were developed for fresh apples using information for Washington State Red Delicious Apples in four cities (Seattle, Los Angeles, New York, and Chicago) and applesauce statistics for Detroit and Pittsburgh. In both cases a linear regression equation was estimated.

[13] Restricted least squares was applied due to the modeling requirement that the cross quantity coefficients

Solution Algorithm

A quadratic programming (QP) algorithm developed at Iowa State University and called ZORILLA was used to solve the empirical model. ZORILLA incorporates the simplex method with a procedure for choosing incoming and outgoing vectors developed by Van de Panne and Whinston [19]. The primal-dual simplex tableau for the model was 482 × 482 (not including slack activities), and the average execution time with ZORILLA was one minute and 40 seconds at a cost of about $16 on the University of Connecticut IBM 360/65. The short execution time and low cost make it feasible to utilize the model as a policy tool.

Empirical Solution

The QP activity analysis solution not only provides optimal values for the quantities harvested, stored, packed or processed, shipped, and consumed but also production and marketing prices as well as resource evaluations (i.e., on-tree apple and CA storage values or rent). The original optimal solution differed somewhat from the benchmark industry statistics. It is believed that these discrepancies primarily resulted from the exclusion of RA storage activities from the model. No RA storage cost was incurred in the model in making available apples during the December-March period when in fact this is not the case. Thus, the optimal solution tended to allocate more fresh apples into time period one (September-March) and less to period two (April-August) than 1969/70 industry statistics indicated. Adjustments were made to the demand intercepts (Table 3) to correct for this problem. The signs of the adjustment factors in Table 3 show that in nearly all cases, the fresh apple demand equations were shifted upward in period two and downward in period one in order to reallocate consumption so as to provide a solution more nearly comparable with industry statistics;[14] this solution is hereafter referred to as the "BASE" model. Some comparisons of the BASE model solution and industry benchmark statistics are provided in Table 4.

The Model's Use as an Economic Tool

To use the model as a policy tool, changes in appropriate parameters may be introduced to simulate the desired circumstance. The revised empirical model may then be solved and the impact of the assumed changes determined by comparing the new solution with that of the BASE model. To illustrate the model's application, analysis was made of the impact of seven regional supply reduction plans, involving 10 and 30 percent reductions in regional 1969/70 on-tree apple supplies, on industry and regional annual

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for fresh apples and applesauce be equal. The estimated U. S. per capita equations were:

$$QA = .5187 - \underset{(.0178)}{.2855PA} + \underset{(.0456)}{.0937PS} + \underset{(.0380)}{.2244Y}$$

$$\begin{aligned} QS = 1.0787 &+ \underset{(.0458)}{.0937PA} - \underset{(.0975)}{.1281PS} - \underset{(.1103)}{.0796D1} \\ &- \underset{(.1559)}{.2558D2} - \underset{(.2646)}{.5674D3} - \underset{(.0070)}{.0095T} \end{aligned}$$

where

QA = U. S. per capita retail consumption of fresh apples (pounds);

QS = U. S. per capita retail consumption of applesauce (303 cans);

PA = U. S. retail fresh apple price deflated by Consumer Price Index (cents per pound);

PS = U. S. retail applesauce price deflated by Consumer Price (cents per 303 can);

Y = U. S. per capita average disposable personal income deflated by Consumer Price Index (tenths of a dollar);

DJ = dummy shifter variables for applesauce production and marketing seasons ($J = 1$ [Jan.-Mar.], $J = 2$ [Apr.-May], and $J = 3$ [June-Aug.]);

T = trend;

and

( ) = standard errors of the coefficients.

Note that using quantity as the dependent variable will result in a more inelastic estimate of demand than if price was used. The quantity dependent form was chosen based on consideration of demand theory and to facilitate derivation of the regional and temporal equations.

[14] Evaluation of the representativeness of alternative specifications of the model was performed by minimizing the square of the deviations of the solution values from the benchmark statistics.

Table 1. Empirical model regional data estimates for the 1969/70 crop year: costs, technical coefficients, on-tree apple supplies, and controlled atmosphere storage capacity

Item	Production Region					
	1	2	3	7	8	9
Costs[a]						
Harvesting (¢/lb.)	1.1	1.0	1.0	.7	.8	.9
CA Storage (¢/lb.)	1.5	1.5	1.4	1.6	1.4	1.0
Sauce Storage (¢/can)	.2	.2	.2	.2	.2	.2
Fresh Packing (¢/lb.)	3.0	3.2	3.5	4.0	3.7	3.2
Sauce Processing (¢/can)	11.4	10.0	10.9	11.4	11.4	8.9
Technical Coefficients						
Harvesting (lbs. to lbs.)	1.119	1.091	1.081	1.036	1.036	1.074
CA Storage (lbs. to lbs.)	.932	.929	.922	.957	.957	.960
Fresh Packing (lbs. to lbs.)	1.256	1.456	1.534	1.264	1.445	1.912
Sauce Processing (lbs. to 303 cans)	2.750	2.957	2.929	3.135	3.135	3.287
On-tree Apple Supplies (millions of lbs.)						
Fresh ($t = 1$)	661.8	396.4	489.5	1204.3	73.5	152.3
Dual Purpose ($t = 1$)	404.7	1183.3	709.9	791.7	82.3	266.7
Processing ($t = 1$)	180.4	—	18.3	—	2.0	—
Fresh ($t = 2$)	33.5	21.1	35.2	—	.3	119.0
CA Storage Capacity (millions of lbs.)	256.176	60.758	120.318	493.438	.436	44.035

[a] Estimated costs are for time period one. Period two figures are obtained by multiplying by the discount term, .962.

Table 2. Empirical model regional data estimates for the 1969/70 crop year: fresh apple and applesauce transportation and marketing costs[a]

Production Region	Consumption Region								
	1	2	3	4	5	6	7	8	9
Fresh Apple Transportation Costs (¢/lb)									
1	—	1.0	1.2	1.3	2.2	2.3	3.2	2.4	3.0
2	.9	—	1.2	1.1	2.2	1.9	3.6	2.3	3.5
3	1.4	1.2	—	1.1	1.4	1.4	3.0	1.6	3.1
7	2.6	2.6	2.0	2.4	1.8	2.6	—	1.7	1.5
8	2.8	2.6	1.9	2.3	1.1	1.3	1.8	—	1.4
9	4.3	4.2	3.2	3.4	2.1	2.4	2.2	1.6	—
Fresh Apple Wholesale and Retail Costs (¢/lb)									
1	12.0	8.8	9.0	10.2	11.7	14.7	13.3	12.4	15.7
2	12.9	7.8	9.0	10.0	11.7	14.3	13.7	12.3	16.2
3	13.4	9.0	7.8	10.0	10.9	13.8	13.1	11.6	15.6
7	14.6	10.4	9.8	11.3	11.3	15.0	10.1	11.7	14.2
8	14.8	10.4	9.7	11.2	10.6	13.7	11.9	10.0	14.1
9	16.3	12.0	11.0	12.3	11.6	14.8	12.3	11.6	12.7
Applesauce Transportation Costs (¢/can)									
1	—	.8	.7	.9	1.4	1.2	2.0	1.4	2.0
2	.7	—	.8	.6	1.4	1.2	2.0	1.4	2.0
3	.8	.8	—	.8	1.1	1.0	1.9	1.0	1.9
7	2.0	2.0	1.8	2.0	1.1	1.8	—	1.3	1.2
8	1.9	1.9	1.0	1.8	.9	1.2	1.5	—	1.5
9	2.0	2.0	1.8	2.0	1.3	1.7	1.0	1.3	—
Applesauce Wholesale and Retail Costs (¢/can)									
1	4.1	3.9	6.6	3.8	4.9	8.5	7.4	4.9	3.8
2	4.8	3.1	6.7	3.5	4.9	8.5	7.4	4.9	3.8
3	4.9	3.9	5.9	3.7	4.6	8.3	7.3	4.5	3.7
7	6.1	5.1	7.7	4.9	4.6	9.1	5.4	4.8	3.0
8	6.0	5.0	6.9	4.7	4.4	8.5	6.9	3.5	3.3
9	6.1	5.1	7.7	4.9	4.8	9.0	6.4	4.8	1.8

[a] Estimated costs are for time period one. Period two figures are obtained by multiplying by the discount term, .962.

Table 3. Empirical model data estimates for the 1969/70 crop year: fresh apple and applesauce regional and temporal retail demands, including adjustment factors for intercepts

		Fresh Apple Coefficients				Applesauce Coefficients		
Region	Time Period	Constant	Adjustment Factor	Fresh Apple Quantity	Applesauce Quantity[a]	Constant	Adjustment Factor	Applesauce Quantity
1	1	38.4916	—4.5	—.023277	—.017021	36.3578	—1.0	—.051874
1	2	36.4167	— .5	—.032103	—.023475	30.4068	—2.0	—.071542
2	1	32.8491	—6.4	—.027856	—.020370	32.2318	—2.0	—.062078
2	2	30.8175	.5	—.038469	—.028131	26.3133	—2.7	—.085730
3	1	34.9353	—3.0	—.014760	—.010794	33.7572	4.5	—.032894
3	2	32.5486	—	—.020355	—.014884	27.5785	2.0	—.045361
4	1	29.5712	—2.5	—.050900	—.037220	29.8344	— .2	—.113432
4	2	27.4967	4.0	—.070033	—.051212	23.8833	.4	—.156072
5	1	32.7412	—1.7	—.227809	—.166587	32.1533	—	—.507682
5	2	29.6518	3.3	—.315608	—.230790	25.4619	.2	—.703345
6	1	31.2767	—1.0	—.040197	—.029394	31.0816	2.0	—.089581
6	2	29.3458	6.2	—.055367	—.040487	25.2361	3.5	—.123387
7	1	34.4428	—2.2	—.139884	—.102291	33.3963	2.0	—.311737
7	2	32.1570	.7	—.192255	—.140587	27.2920	—	—.428447
8	1	32.3470	—1.7	—.132795	—.097107	31.8638	—	—.295939
8	2	30.6724	3.2	—.181798	—.132940	26.2031	—	—.405143
9	1	38.9076	—4.5	—.043487	—.031800	36.6616	—5.2	—.096913
9	2	37.1237	.1	—.059923	—.043819	30.9246	—5.6	—.133540

[a] The fresh apple quantity variable in the applesauce equation has these same coefficients due to the symmetric cross quantity condition (refer to footnote 13).

Table 4. U. S. apple industry model solution: solution values for regional and temporal fresh apple and applesauce retail consumption and retail prices, including *a priori* estimates[a]

	Region									
Item	1	2	3	4	5	6	7	8	9	Total
Fresh Consumption (millions of lbs.)										
sol. $t = 1$	580	403	1040	199	59	228	112	99	315	3035
sol. $t = 2$	156	100	258	43	13	65	28	26	93	782
est. $t = 1$	570	325	925	178	56	225	93	93	298	2763
est. $t = 2$	170	97	276	53	17	67	28	28	89	825
Applesause Consumption (millions of 303 cans)										
sol. $t = 1$	97	53	152	27	7	33	14	11	43	437
sol. $t = 2$	60	35	84	18	5	23	9	9	29	272
est. $t = 1$	86	46	130	24	7	31	13	11	36	384
est. $t = 2$	56	30	85	16	5	20	8	7	24	251
Fresh Retail Prices (¢/lb.)										
sol. $t = 1$	18.8	13.7	14.9	15.9	16.4	20.1	15.2	16.4	19.3	
sol. $t = 2$	29.5	26.5	26.1	27.6	27.6	31.1	26.4	28.0	30.4	
est.	22.7	17.6	17.6	18.9	19.6	23.2	20.4	20.3	24.1	
Applesauce Retail Prices (¢/303 can)										
sol. $t = 1$	20.4	18.7	22.0	19.1	18.9	23.4	19.7	19.0	17.3	
sol. $t = 2$	20.4	18.8	21.9	19.2	18.9	23.3	19.7	19.1	17.4	
est.	18.5	17.5	20.3	17.3	17.9	21.8	19.8	17.9	16.1	

[a] Estimates of regional and temporal consumption were derived by applying mid-period regional population estimates for 1969/70 to U. S. average per capita consumption figures for each time period. These estimates, however, do not represent any regional differences in consumption habits. To reflect differences, the above estimates were adjusted by *Household Food Consumption Survey, 1965–66* (Spring) estimates [17] of regional consumption as well as for the impact of regional income differences on consumption. Retail price estimates are the regional representative city prices used in generating the wholesale-retail marketing margins.

f.o.b. net returns (i.e., net returns from the combined sales of fresh apples and applesauce at the packer or processor level and denoted hereafter by FOBNR).[15] These apple supply reductions could have resulted from industry control of supplies[16] or some random event such as adverse weather.

The regional areas where the reductions in apple supplies were assumed to occur were: (1) West Coast (Northwest and California); (2) Lake States; (3) East Coast (Northeast and Appalachia); (4) East Coast and Lake States; (5) Lake States and West Coast; (6) East and West Coasts; and (7) all production areas except the Southwest.[17] (Table 5 presents the regional 1969/70 on-tree apple supplies and the quantity of apples reduced in each plan.) Note that within any plan, the percentage reductions in supply refer to particular regions, and a 10 percent reduction in one region is not necessarily the same quantity as a 10 percent reduction in another.

The data in Table 5 indicate that every crop reduction analyzed increased industry FOBNR, and within any particular plan, a 30 percent reduction in regional crop size increased FOBNR more than a 10 percent reduction. The increases in FOBNR ranged from $2.756 million or 1.7

Table 5. Changes in regional f.o.b. net returns from the BASE solution, BASE model regional on-tree apple supplies and regional supply reductions

Supply Reduction Plan and Size of Reduction	Regional Changes in F.O.B. Net Returns from Base Plan							On-Tree Supply Reduction
	1	2	3	7	8	9	U. S.	
	Million dollars							Millions of Pounds
BASE Solution	42.905	26.863	31.343	42.563	2.209	18.328	164.210	—
(1) West Coast								
10 percent	1.543	2.175	2.141	2.172	.275	—.887	7.420	253.4
30 percent	6.145	8.658	6.963	5.753	.927	—2.914	25.533	760.2
(2) Lake States								
10 percent	.794	1.154	—1.389	1.733	.153	.311	2.756	125.2
30 percent	2.484	3.366	—5.239	4.432	.388	.816	6.247	375.9
(3) East Coast								
10 percent	—.744	—.038	2.002	2.780	.262	.522	4.784	288.0
30 percent	—1.507	2.184	10.125	9.308	.791	1.819	22.722	864.2
(4) East Coast and Lake States								
10 percent	—.037	1.056	.479	4.520	.409	.844	7.372	413.2
30 percent	2.035	8.315	1.601	20.770	1.787	4.079	38.589	1240.1
(5) Lake States and West Coast								
10 percent	2.368	3.219	.213	3.231	.378	—.676	8.733	378.6
30 percent	9.666	18.832	2.674	13.573	2.015	—1.509	45.251	1136.1
(6) East and West Coast								
10 percent	.734	2.014	4.007	4.600	.493	—.418	11.430	541.4
30 percent	5.612	14.441	22.673	22.592	3.368	.318	68.868	1624.4
(7) All Production Areas Except Southwest								
10 percent	1.445	2.935	1.986	5.598	.579	—.220	12.324	666.6
30 percent	9.504	21.369	12.795	29.602	4.321	1.891	79.483	2000.3
Average of All Plans	3.116	6.872	4.631	10.031	1.234	.342	26.230	
BASE Model On-Tree Supplies (Mill. of pounds)	1280.4	1600.8	1252.9	1996.0	158.1	538.0	6826.2	

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[15] The f.o.b. level was chosen for analysis since it is the most predominant initial marketing level for apples. According to a 1969/70 survey [9, p. 4], over 90 percent of all fresh apples marketed at f.o.b. are derived from packers' own acreage and from cooperative members or are packed on consignment. First sales of apples for applesauce are made more commonly at the processing plant door; but with a substantial portion of the processing apples being handled by cooperatives, the f.o.b. shipping point level was also selected for analysis.

[16] The apple industry cannot currently control apple supplies directly but could indirectly affect supplies by respecifying quality and size standards or through a voluntary program.

[17] The Southwest (region 8) was not included in the plans due to its relative unimportance as a national supplier of apple products.

percent of the BASE solution industry FOBNR (Lake States: 10 percent reduction) to $79.483 million or 48.5 percent (all production regions except the Southwest: 30 percent reduction).

It was generally found that the larger the size of the crop reduction, the larger was the increase in industry FOBNR.[18] However, some plans increased industry FOBNR more than others with a similar reduction in marketings. For example, the 10 percent level of plan 1 restricted on-tree apple supplies by 34.6 million pounds less than the 10 percent level of plan 3, while plan 1 increased industry FOBNR by $2.636 million more than plan 3. The reason for these differences lies in the varying levels of regional FOBNR and the responsiveness of regional f.o.b. price increases to apple supply reductions.

If one was in the position of manipulating regional apple supplies to increase industry FOBNR, one policy objective would be to increase industry FOBNR while minimizing losses in quantities of apple products available to the consumer. With such a criterion, plan 1 is more beneficial than plan 3. If the goal was simply to maximize the increase in industry FOBNR without any side conditions, the overall choice of the plans considered would be the 30 percent level of plan 7. However, this does not mean that one of the other plans could not produce a larger increase in industry FOBNR with a cut in the crop size of two billion pounds.

A consideration not yet examined here is the relative impact of the alternative plans on the various regions. Changes in regional FOBNR differed within each plan studied (Table 5). For example, a 30 percent reduction in Lake States and West Coast 1969/70 apple supplies resulted in a $20.341 million difference between changes in FOBNR for Appalachia and California ($18.832 and — $1.509 million, respectively). This variation in regional impact is quite substantial when compared to the BASE solution FOBNR and certainly would be a major consideration in policy formulation.

The plans which reduced apple supplies in rather limited geographic areas (i.e. (1) Northwest, (2) Lake States, and (3) East Coast) usually resulted in the region in which supplies were reduced incurring losses in FOBNR. For example, the 30 percent reduction in the Lake States caused it to lose $5.239 million in FOBNR while the Northeast, Appalachia, and the Northwest benefited by this action by a combined total of $10.282 million. The Northwest was an exception in that it did not experience a decline in FOBNR in any of the limited geographic plans, no doubt due to the predominant position of the region in U. S. supply. When crop reductions involved more than one regional area (i.e., plans 4, 5, 6, and 7), only a few cases of regional FOBNR losses resulted. Thus, coincident reductions in apple supplies in a number of production regions lessened potential losses in regional FOBNR.

California sustained losses in FOBNR in nearly every plan, probably due to its very close proximity to the vast apple quantities in the Northwest. The Northwest and Southwest experienced no losses in FOBNR at all. An average of FOBNR changes across all plans (Table 5) showed the Northwest to have had the largest average increases in FOBNR ($10.031 million) and California the least ($0.342 million), reflecting in part the relative sizes of production.

Clearly, a reduction in crop size (whether by adverse weather or deliberate policy) would have a substantially different impact on each region's FOBNR. These results would provide very useful information if, for instance: the industry tended to compensate regional producers who suffered losses in crop due to weather damage; the industry was in a position to manipulate apple supplies during a crop year to increase industry or regional FOBNR; or a region considered managing its own intra-yearly apple supplies.

Model Limitations

Any model is an abstraction and thus rests upon assumptions and simplifications. The U. S. apple industry model is certainly no exception. A number of complicating factors were not considered because of data limitations and to keep the programming problem down to a manageable size. Some of the model's limitations are as follows: only one processed apple product was studied, due to lack of available data, when apple slices and juice products are also of considerable importance; apple quality variations and pricing differences among varieties were not investigated; the model specification did not include time periods that would reflect RA storage of fresh apples; and the analysis was short run in nature and therefore would not provide answers to longer run questions (e.g., what would happen in the second or third year after a region lost part of its tree population due to adverse weather or in the years thereafter if growers expanded production due to short run price increases?).

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[18] It is important to note that increases in FOBNR could not be expected to continue with increasingly larger reductions in apple supplies. At some point the elastic portion of the f.o.b. level derived demand functions would be reached and reductions in FOBNR would result. Note also that per unit costs were not adjusted associated with the size of the reduction in apple supplies. This is a simplistic assumption, but a necessary one due to data limitations, which may tend to overstate FOBNR increases in the 30 percent reduction plan. Some per unit cost increases could be anticipated, especially in the applesauce sector.

The model can provide insights into future industry relationships assuming the structure of the industry does not substantially change. The model's use is in no way limited to studying the effects of supply changes (not discussed here are its impact on alternative marketing level prices, interregional commodity flows, substitution between fresh apples and applesauce, and stored quantities). It can also be utilized in studying the effects of changes in consumer demand, transportation costs, marketing margins, production costs and coefficients, and varietal plantings.

The QP activity analysis formulation with its ability simultaneously to incorporate multiple regions, commodities, time periods, production activities, storage functions, and marketing levels, provides a very powerful and flexible empirical tool for research. Although analyses using this methodology have been cast in a perfectly competitive framework, it is also possible to extend the analysis to certain noncompetitive market structures [20; 11, Ch. 11]. Takayama and Judge have suggested additional extensions to spatial and temporal analysis via optimal control [12] and adaptive programming [11, Ch. 19] formulations. The integrability restriction placed on this study can be circumvented by reframing the modeling form to incorporate explicitly all the competitive spatial and temporal equilibrium conditions in the constraint set. However, the size of the programming problem can be significantly increased unless an asymmetric QP algorithm is used. Development of a very efficient asymmetric QP algorithm, able to handle rather sizable programming problems, would facilitate further development of more realistic modeling efforts which are economical enough to be used as a working tool for policy analysis.

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Editor's Note: After conditionally accepting the following article, we were unable to make contact with the surviving author, Dr. Raul Fiorentino. Since this was the last issue for which we had editorial responsibility, we decided to publish the article essentially in the form in which it was reviewed.

Rural Poverty and Government Intervention: The Case of the Argentine Yerba Mate Industry*

RAUL FIORENTINO AND GERALD W. DEAN

A simple econometric model was used to demonstrate that government intervention in the yerba mate market has favored large producers and processors in the Argentine province of Misiones. Large producers have benefited not only through high price supports but also by integrating vertically to appropriate the price support benefits intended for small farmers. An alternative mixed policy strategy believed to be both economically feasible and politically acceptable was proposed to alleviate rural poverty associated with the yerba mate industry. This policy includes changes in land tenure and farm operational systems along with modifications in current price policy.

Key words: **rural poverty; income distribution; land reform; government policy; yerba mate; Argentina.**

THIS PAPER SUMMARIZES a study of the rural poverty problem in the Misiones Province of Argentina. The region specializes in the production of yerba mate, used to produce a tea-like drink consumed in several Latin American countries. The objectives here are two. First, by way of a simple econometric model it will be shown that government intervention in the yerba mate market has favored large producers and processors and has disadvantaged small farmers.[1] The income distribution effects in this intervention have been especially perverse, in that large efficient producers not only secured windfall gains through high support prices but also, due to the peculiar characteristics of marketing legislation in the industry, were able to integrate vertically and to appropriate price support benefits initially intended to accrue to small farmers. Second, several alternative government policy proposals will be considered in terms of their potential impact on rural poverty in the region. Detailed analysis is made of a mixed policy strategy (i.e., one which includes changes in both land tenure and farm operational systems, together with modifications in the current price policy). It is concluded that an economically feasible and politically acceptable approach toward solution of the poverty problem exists in the region of yerba mate production.

Historical and Institutional Setting

The geographical focus of this study is the Province of Misiones, one of the most backward areas of Northeast Argentina. The area was settled in "colonies" at the end of the nineteenth century through massive immigration from Europe. Typically the Argentine government granted the settlers individual farm units of 25 hectares. Simultaneously many parcels of high-quality Misionean lands were sold as large private farming units. Large and small holdings continue to exist today—over 60 percent of the approximately 31,000 producers in Misiones hold plots of less than 25 hectares—but their output is more than matched by the less than 3 percent of producers with farms over 625 hectares. In 1969, 13,000 farms produced yerba mate in Misiones; the crop accounted for approximately

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[1] The Argentine government justifies a program of farm price supports and regulation of aggregate supply of yerba mate in terms of improving the incomes of small farmers. Experience elsewhere offers little *a priori* encouragement for expecting positive equity effects of such programs. To cite only one example, the cotton program in the U. S., originally justified to help the poor southern farmer, resulted in windfall gains to large producers and minimal help to those it was presumably designed to assist. For a more detailed discussion of the income distribution effects of cotton and other U. S. farm programs, see Bonnen [1].

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40 percent of the total cultivated area and was the leading revenue producer, accounting for 27 percent of the gross value of Misionean farm production. Yerba mate is by far the major source of incomes on small farms.

Conditions favoring production of specialized perennial crops (yerba mate, tung, and tea) with high revenues per hectare encouraged rapid development in the first half of this century and allowed small farmers to attain acceptable living standards. But decline in domestic demand for yerba mate and increased international competition in tung and tea markets brought first a period of stagnation in regional development and then, in the last 15 years, sharply depressed incomes on small farms. Yerba mate *gross* revenue per farm is currently less than half the level in the 1950s, resulting in *net* incomes for the majority of yerba mate producers well below that of a full-time city worker (6,000 A$ per year, which is estimated barely to cover family food costs).

Since 90 percent of Argentine yerba mate production comes from the Province of Misiones and is particularly important on small farms, it appeared natural to attack the area's poverty problem through government intervention in yerba mate production and marketing. Thus, in response to expanded production and low prices in the early 1930s, the Yerba Mate Production and Trade Regulating Board (CRYM) was created to maintain farmer incomes via supply control and enforced target prices for yerba mate. A mixed private-public institution which has operated continuously since 1936, the CRYM is composed of representatives of producers, millers, consumers, provincial banks, and officers of the Federal Government. Its central function is to set annual "fair" target prices to producers, to estimate the global target quantity demanded by the industry with corresponding market quotas for each producer proportionate to his "base" production, and to operate a consignment agency (CA) to purchase yerba mate from farmers and regulate releases to the processing sector. The farmer who consigns his production to the CA receives an initial payment (A), less than the target price (PT), followed by a remaining payment (PT-A) when *all* of a given year's harvest has been released to processors. An important feature of the system is that farmers are not obliged to sell to the CA—they may sell part or all of their production quota directly to the processing sector.

From a producer standpoint the system performed smoothly until 1953—new plantings were prohibited, producers enjoyed high prices, and marketing quotas were gradually enlarged and then eliminated as domestic demand increased. Subsequently (1955–57), limited new plantings were permitted on small farms, but when production did not expand sufficiently to meet demand, large producers and integrated producer-millers demanded and gained government permission for virtually unlimited new plantings. Massive new plantings in the next two years (almost equal to the existing bearing acreage), mostly by large producers with access to credit, brought on a second over-supply crisis, huge stock accumulations, and restoration in 1964 of the marketing quota system. However, marketing quotas in 1964 and 1965 were set so high that stocks continued to grow. In an abrupt about-face, the Government *prohibited* the 1966 harvest (at great cost to producers) and from 1967 through 1971 reduced quotas sharply to bring stocks back to "normal" (pre-1963) levels. For example, in recent years a 25-hectare farmer typically has been allowed to harvest only about 30 percent of his trees.

In summary, the free planting measure resulted in an increased concentration of production in large units to the detriment of production and income on small farms. In addition, as will be documented below, small farmers were further disadvantaged by the government's erratic quota and stock policy in the 1960s and the consequent development of "free market" transactions of small producers directly with more powerful processors and vertically integrated producer-processors.

The yerba mate industry provides an example of a stable coexistence of large and neighboring small holdings (*latifundia* and *minifundia*), characterized by symbiotic relationships between farm types. The most typical of these relationships is well known [4]—large plantations producing labor-intensive commercial crops, surrounded by *minifundia* producing only subsistence crops and providing plantation owners with cheap family labor. It will be shown here that government marketing policy in yerba mate has become the mechanism by which incomes have been transferred from small producers to large producer-processors.

An Econometric Model of the Industry

A simple econometric model of the Argentine yerba mate industry, using data for the period 1955–71 is summarized in equations (1) to

Table 1. Summary of econometric model of the yerba mate industry

Sector	Equations and Estimates of Parameters[a]	Statistics[b]
I.	*Consignment Agency (CA) Policy*	
	CA price to farmers (1) $PEF = -4.43 + 1.12PT - 0.01SCA_{-1}$ (−1.50) (6.14) (−1.02)	$\bar{R}^2 = 0.84$ $ds = 2.14$
	CA price to processor (2) $PCA = 11.07 + 0.41PT_{-1} - 0.13L - 0.03SCA_{-1}$ (6.13) (3.79) (−4.99) (−4.10)	$\bar{R}^2 = 0.75$ $ds = 1.76$
II.	*Farm Sector Behavior*	
	Yield levels (3) $YE = 1000 + 137AI - 606R_{-1}$ (6.99) (9.81) (−4.83)	$\bar{R}^2 = 0.88$ $ds = 2.13$
	Aggregate supply (4) $QS \equiv YE \cdot HA$	
	Supply to free market (5) $QFM = 5.70 + 3.54(PCA - PEF) + 0.49QFM_{-1}$ (1.91) (3.01) (2.02)	$\bar{R}^2 = 0.83$ $ds = 1.72$
	Supply to CA (6) $QSC \equiv QS - QFM$	
III.	*Retail and Processor Behavior*	
	Per capita consumption (7) $Q/N = 0.80 - 5.13 \ln K + 0.40Q/N_{-1}$ (1.51) (3.53) (2.58)	$\bar{R}^2 = 0.81$ $ds = 2.31$
	Aggregate consumption (8) $Q \equiv Q/N \cdot N$	
	Aggregate intermediate demand (9) $D = Q - M$	
	Retail price determination (10) $PR = 2.07PCA$ (13.50)	$\bar{R}^2 = 0.91$ $ds = 1.72$
	Processor demand from CA (11) $QDC \equiv D - QFM$	
IV.	*Stock Formation* (12) $SCA \equiv SCA_{-1} + QSC - QDC$	

[a] Numbers in parentheses refer to t-statistics. Variables in the model are as defined below:

PEF = Price paid to farms by the CA,
PT = Current target price,
SCA_{-1} = Lagged stocks in the CA,
PCA = Price paid by processors to the CA,
PT_{-1} = Lagged target price,
L = Inflation rate,
AI = Age composition of the stocks of trees,
R_{-1} = Lagged ratio of harvested to planted trees,
QS = Annual aggregate farm supply,
HA = Harvested area,
QFM = Current quantity allocated by farmers to the free market,
QFM_{-1} = Lagged quantity allocated by farmers to the free market,
QSC = Quantity allocated by farmers to the CA,
Q/N = Current per capita consumption (Q = consumption; N = population),
K = Urban concentration index,
Q/N_{-1} = Lagged per capita consumption,
D = Domestic quantity demanded by the processing sector,
M = Imports,
PR = Price to retail,
QDC = Quantity demanded by the processing sector from the CA, and
SCA = Current stocks in the CA.

[b] $\bar{R}^2$ and ds refer, respectively, to the correlated coefficient of determination and the Durbin Watson statistic.

(12), Table 1. The principal decision makers in the model are the government, the farm sector, processors (millers), and consumers. The *government* (through the CA) sets target prices which, together with lagged stocks and the inflation rate, determine effective official prices to farmers[2] and to processors (eqs. 1 and 2). In years of marketing quotas the government also determines aggregate supply (eq. 4). In the *farm sector* yields per hectare are determined by the age composition of trees and the lagged ratio of harvested to planted area (eq. 3). In years of no controls output is simply yield times harvested area (eq. 4). The model assumes that farmers allocate supplies to the "free market" (direct sales to processors) on the basis of the difference between the official and free market prices (eq. 5).[3] Their remaining production then goes to the CA (eq. 6).

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[2] $PEF = A + (PT - A)/(1 + L + i)^t$, where PEF is price paid to farmers by the CA, A the initial payment, PT the target price, L the inflation rate, i the discount rate, and t the time lag between initial and final payment.

[3] Due to lack of data, a usable series of free market prices could not be constructed. But, since fragmentary evidence showed a close relationship between changes in the prices paid by millers to the CA (PCA) and price

Per capita *consumer* demand for yerba mate (eq. 7) is a function primarily of habit (reflected by lagged per capita consumption) and changes of tastes (reflected by an index of urbanization). Declines in per capita consumption over time were found to be unrelated to declining retail prices and increasing incomes (i.e., the price and income elasticities were not significantly different from zero). Imports were treated as exogenous (determined primarily by government quota policy), so that aggregate demand for domestic production was a residual (eqs. 8 and 9). The processor and retail sectors follow a contant percentage mark-up policy (eq. 10). Processors purchase their yerba mate in the "free market" (directly from farmers) and from the CA; their supplies from farmers are determined by farmer allocation decisions (eq. 5), and their residual supplies are purchased from the CA (eq. 11). Stock levels at the CA are determined by a simple identity (eq. 12).

Tests of income distribution effects

As described above, during the 1957–59 "free planting period" large integrated producer-processors with ready access to credit sharply increased their plantings of yerba mate; when proportional marketing quotas were subsequently imposed, they gained a larger permanent share of the market.[4] This combination of measures probably produced a major redistribution of income from small to large farmers. The above econometric model will be used to test whether small farmers were also disadvantaged by the government's marketing quota-stock policy, which permitted large quotas in 1964 and 1965 (and therefore necessitated large stock build-ups to maintain prices) followed by sharp reductions in quotas to work off the excess stocks from 1966 to 1971 (Actual Quota policy). Specifically, it is hypothesized that, compared with a policy of setting quotas at a quantity which would have maintained approximately constant prices and stocks (a Normal Quota policy leading to constant stocks of about 100,000 tons over the 1964–71 period), the Actual Quota policy (1) increased processor incomes, (2) reduced producer incomes, and (3) redistributed income against the poorest farmers.

Since total quantities handled and sold by processors over the period in question are approximately equal under both policies (actual stocks had been reduced to normal by 1971), and since processor sales prices on all yerba mate sold are based on a percentage mark-up from *official* (CA) prices, the hypothesis of *increased processor incomes* is supported if the following three testable propositions are sustained:

Proposition 1: The processing sector has paid lower average prices to the CA (official market) under Actual Quotas than would have been the case under Normal Quotas.

Proposition 2: The processing sector obtained a larger share of its supplies from the free market (i.e., directly from farmers) under Actual Quotas than would have been the case under Normal Quotas.

Proposition 3: The processing sector paid even lower prices in the free market than to the CA.

Manipulation of the system of equations (1) to (12) permits expression of the price paid by processors to the CA (PCA) as a function of exogenous and lagged endogenous variables, including the level of annual supply determined by the marketing quotas. Under the policy of Normal Quotas, average prices paid by the processing sector to the CA for the period 1964–70 would have been approximately 20 percent higher than was the case under Actual Quotas, thus supporting Proposition 1. The reason is as follows: with large stock accumulations at the CA under Actual Quotas, the price set for sale to processors (PCA) was based on lagged target prices over several years which, due to high inflation were considerably lower than the one-year lagged target price relevant for the case of Normal Quotas. Proposition 2 is supported by the prediction (from the econometric model) that free market quantities (QFM) averaged 66 percent higher from 1964–70 under Actual Quotas than would have been the case under Normal Quotas. Proposition 3 cannot be tested directly from the econometric model because complete time series data on free market prices (direct sales) were unavailable. But some tentative support for Proposition 3 was obtained by direct interviews in 1971 and 1972 showing that weighted average yerba mate prices paid by processors in the free market (direct from

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changes in the free market, PCA was used as a proxy for free market prices in allocation equation (5). Lack of free market data made it impossible to treat this segment of the industry in a more realistic simultaneous fashion.

[4] The same phenomenon has been observed in the U. S., where cotton and feed grain bases were deliberately built up by some farmers during periods of temporary removal of controls.

farmers) were 12 percent lower than at the CA.[5]

Interviewing revealed that farmers sold free market yerba mate to processors in two different processing stages. "Dry" yerba mate sales, which incorporate some on-farm processing, were made by the wealthier farmers, whereas "green" yerba mate sales were made by the poorer farmers, whose financial situation forced them to sell their production "on the tree." Green sales were reimbursed in cash, whereas dry sales were reimbursed partly in cash and partly in quarterly payments. On the basis of plausible values of inflation (30 percent) and discount rates (10 percent), analysis showed that while "dried" prices were about equal in the official and free markets, processors paid only about three-fourths as much for green yerba mate (comprising about 40 percent of free market sales) as for dried [3].[6]

The hypothesis of reduced producer incomes as a result of CA policy can be tested through Propositions 4 and 5.

Proposition 4: Prices received by farmers from the CA from 1964–70 averaged lower under Actual Quotas than would have been the case under Normal Quotas.

Proposition 5: Weighted average prices of dried and green yerba mate received by farmers in the free market (direct sales to processors) in the same period were lower than in the official (CA) market.

Predictions from the econometric model show that prices received by farmers from the CA (PEF) averaged 20 percent lower under Actual Quotas than would have been the case for Normal Quotas, thus supporting Proposition 4. Again, Proposition 5 was informally tested by interviews in 1971 and 1972; although farmers received approximately the same net price in the official and free markets for *dried* yerba mate, they received net prices 26 percent lower for *green* yerba mate in the free market. Thus the weighted average prices received by farmers were lower, and both Proposition 5 and the general hypothesis that CA policy depressed farm income are sustained.

Why do green yerba mate sellers not shift sales to the higher priced official CA market or, by joining a cooperative, to the dried free market? The problem is that suppliers to the green market are primarily the smallest producers, who face severe capital limitations. Because the initial payment for the consigned merchandise at the CA is insufficient to cover cash cultivation, drying, and transportation costs, the farmer needs cash reserves or credit to carry him until final settlement is made. The small farmer has neither. His possibilities of acquiring credit by joining a drying cooperative are also limited. Cooperatives simply do not exist in many of the poorer areas and, when they do, the required initial capital contribution often exceeds the small farmer's financial resources.

Expressed alternatively, the green yerba mate market exists and increases because small producers (with limited access to capital) have such high subjective discount rates that, to them, the present value of the initial payment plus lagged payments at the CA is lower than the immediate payment in the green market. Given the differential price incentive between dried and green yerba mate, large firms have developed efficient organizations for harvesting green leaves and have built modern processing plants, thereby enlarging their market share.

Analysis of Alternative Policies

The above analysis suggests that continuation of past policies would lead to further expansion of large integrated firms buying a larger proportion of their supplies in the low-priced green market, with unfavorable consequences for farm income distribution. Current policy debate over the industry's problems has centered on two major issues: (a) the inefficient resource allocation caused by a bearing area more than double that needed to meet current demand; and (b) the income distribution effects of the current situation. Because they address two different objectives, two contradictory price policies have been proposed. One, an efficient policy initiated in official circles in Buenos Aires, would reduce the yerba mate farm price and institute compensatory payments to eradicate trees. According to its supporters, this measure would reduce inefficient production and release human and natural resources which are currently wasted in the industry. The other alternative, a poverty oriented policy backed by the small farm unions, would defend the interests of the Misionean small farmers (*minifundista*) by raising price supports for yerba mate (and other products).

Implementation of the efficiency policy probably implies the disappearance of the small farm structure, since large integrated farms are relatively more efficient (based on cost-size studies) and able to withstand substantial price reductions; the small farmers, impoverished and inefficient, would be forced to leave their land or be reduced to subsistence farming. Using the terminology of neoclassical economics, small farmers and their families would be the first "factors" to "adjust" in response to "economic incentives"; in fact, they would probably add to the size of city slums in the Pampean region. On the other hand, implementation of the so-called poverty policy by imposing high target prices would obviously permit large, efficient farmers to earn abnormally high profits. Furthermore, the price increases would need to be unrealistically large to provide the average small farmer with a satisfactory income level within the current farm size structure.

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[5] *Editor's Note:* A referee indicated that lower free market prices in 1971 and 1972 might not support the conclusion of lower prices in the period studied, 1955–71.

[6] *Editor's Note:* Both referees indicated that price differentials between green and dried yerba mate might be justified by the added inputs required. The authors have not established for the reader that the differentials were in fact excessive.

A supplementary policy instrument, suggested by the preceding analysis, would be provision of credit subsidies to small producers. This would go a long way toward eliminating the price discrimination against small producers by permitting them to dry their own yerba mate (avoiding the green market).

None of the above policies, however, provides much promise of an acceptable solution of the *minifundista* (small farmer) problem. Detailed farm budget and linear programming analysis by the authors showed little possibility of generating satisfactory (competitive with industry) levels of income on farms of less than 50 hectares [3]. Thus, a basic structural change in land holdings, involving farm enlargement of over 50 percent of the farms in the region, appears the only feasible longer-term solution for eliminating regional rural poverty. In this light, the economics of a more radical policy—one which would combine both price and credit policy with structural changes in land holdings—were examined.

A proposed policy for structural transformation

Obviously, a structural policy which involves changes in land tenure and farm consolidation will encounter resistance from some farmers. The proposed policy would help to mitigate such problems by providing compensatory payments for early retirement or resettlement of displaced farmers.[7] Further, the financial burden on the government (for credit or technical assistance) and on consumers (in the form of increased taxes or higher consumer prices for yerba mate) will be shown to be minimal or nonexistent. Thus, the proposed policy has the possibility of being considered a serious alternative within the Argentine political context.

In essence the proposed policy would shift yerba mate marketing quotas from small farms in low yield areas (the Campo) to small and medium-sized farms in high yield areas (the Monte), while simultaneously undertaking government intervention in the low yield areas to (1) enlarge farm size, (2) provide credit and technical assistance to introduce alternative production possibilities on small farms, and (3) provide compensatory payments for retirement and resettlement of people unemployed as a result of the policy. The logic of the policy proposal is illustrated in Figure 1. Curves *AB* and *A'B'* are product transformation curves between yerba mate and the best alternative production activity in each region. (Specifically, a combined soybean-beef activity was assumed in both regions.) The transformation curve *AB* in the Campo (area of low yerba mate yields) traces out the production possibilities facing an individual small farmer with fixed land and capital, family labor, and operating capital (credit); curve *A'B'* in the Monte is interpreted similarly.

Initially, assume a free market policy for yerba mate. Farmers in the Campo maximize profits (residual returns to land and family labor) by producing output $\overline{OQ}_1$ at price ratio s_1m_1. The slope of the price ratio line s_1m_1 is the ratio of residual returns to land and family labor for yerba mate and soybean-beef; the level of the price line indicates the level of aggregate residual returns to land and family labor in the region. By a similar argument, farmers in the Monte produce output $\overline{O'Q'}_1$, responding to the price ratio $s'_1m'_1$ (the slopes of s_1m_1 and $s'_1m'_1$ are equal).

Suppose now a marketing quota is implemented (the current policy) in which the output of yerba mate for each firm is cut by the same proportion. The Campo now produces $\overline{OQ}_2$ and the Monte $\overline{O'Q'}_2$. However, because aggregate output is reduced, the yerba mate price increases, resulting in price lines s_1m_2 and $s'_1m'_2$ in the two regions (again, the slopes of s_1m_2 and $s'_1m'_2$ are equal). Due to the low price elasticity of the yerba mate demand function (not significantly different from zero in the econometric model), the yerba mate price increase more than compensates for quantity reductions. Thus both

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[7] These features of the policy have much in common with the so-called Mansholt Plan for restructuring farm size in the European Economic Community [2].

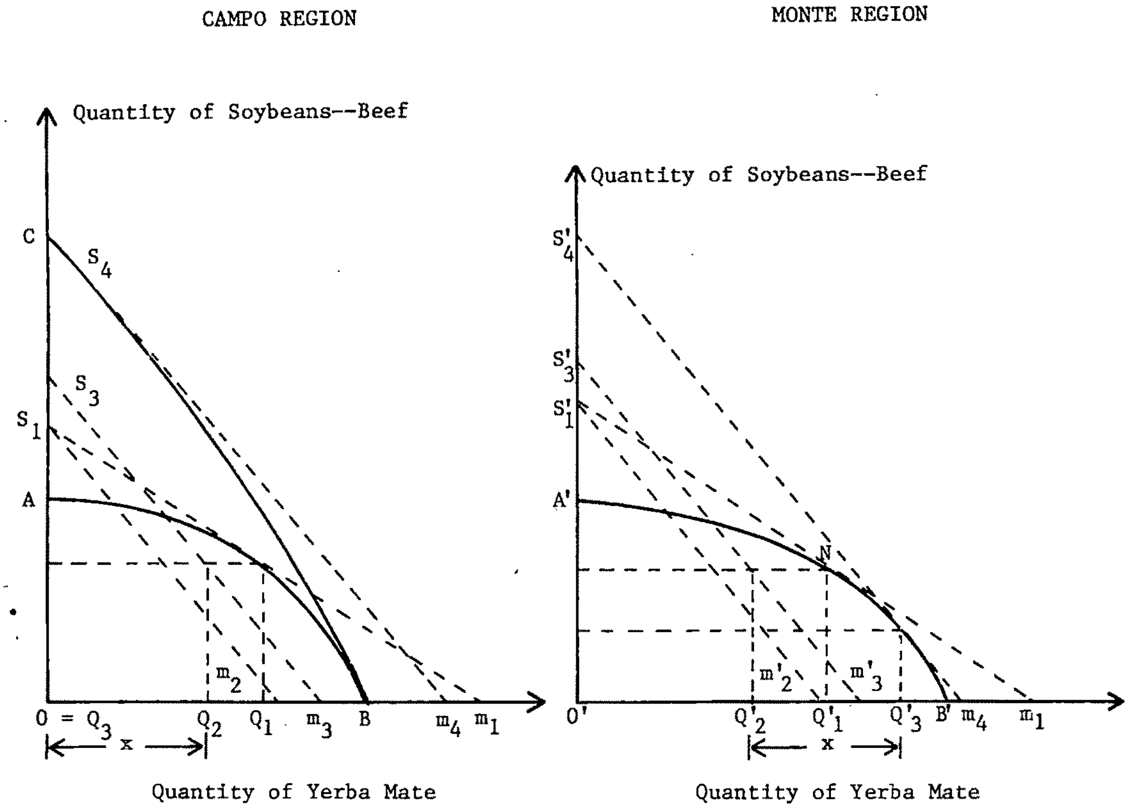

Figure 1. Theoretical illustration of the effects of the yerba mate–farm restructuring policy proposal

Campo and Monte producers are better off after implementation of the marketing order; that is, aggregate returns to land and family labor as given by the levels of s_3m_3 and $s'_3m'_3$ are higher than those given by s_1m_1 and $s'_1m'_1$, respectively.

Consider now the proposed policy, which would shift (part or all) of the current marketing quotas in the Campo to the Monte and would undertake government intervention in the Campo. The result of government intervention in the Campo would be to shift the transformation curve from *AB* to a position such as *CB*. Since the overall marketing quota for the two regions is unaffected (only a shift between regions), the price of yerba mate is unaffected. With the new transformation curve *CB*, the Campo region will produce at point *C* (zero output $\overline{OQ}_3$ of yerba mate) at price ratio line s_4m_4 (equal in slope to lines s_1m_2 and s_3m_3). The Monte produces (point *N*) output $\overline{O'Q'}_3$ of yerba mate at price line $s'_4m'_4$. For the sake of illustration, assume that the added output in the Monte ($Q'_2Q'_3 = x$) is exactly equal to the reduced output in the Campo ($Q_2Q_3 = x$); thus, marketing quotas of x could be transferred from the Campo to the Monte.

The policy would clearly increase income (residual returns to land and family labor) in both regions. However, this would be possible only with a substantial investment in extension activity, provision of credit, and unemployment payments associated with shifting the transformation curve from *AB* to *CB* in the Campo. Further, such a program, analyzed in detail below, probably would be politically feasible only if a sizable proportion of funds for the project were generated within the industry itself.

Components of an empirical analysis of the proposed policy.—The empirical analysis of the above policy involved the following steps:

(1) Detailed technical and budget analysis of production alternatives to yerba mate in a relatively poor pilot area of the Campo.

(2) Synthesis of models of modern farm units, including selection of optimal crop and livestock combinations (by linear programming) dependent primarily on family labor, and determination of minimum farm size (by analysis of economies of scale) which would meet target family incomes.

(3) Analysis of the farms for financial viabil-

ity, tested by comparing loan requirements with income flows. Farms passing this test were selected as potential units for the overall development plan.

(4) Formulation of an aggregate multi-period linear programming model (MPLP) for the pilot area incorporating both traditional and modern farm alternatives, based on a 15-year government project with annual injections of investment funds.

(5) Economic evaluation of the project using benefit-cost analysis.

A brief review of the data and procedures involved in each step will give a flavor of the development problem. At the individual firm level in the Campo, budgets showed that soybeans, forages, beef, and milk production were the most promising individual activities (step 1). Based on the budget information, static LP models (step 2) of three different farm units (of an initial arbitrary size of 100 hectares) were developed: (a) a cattle fattening-forage-soybean farm; (b) a cattle raising-forage-soybean farm; and (c) a dairy-forage-soybean farm. The optimal plans assumed an LP objective function which maximized returns to land and family labor, subject to a series of restrictions on land, forage, and concentrate requirements by time period, and a soybean restriction equal to 25 percent of the land area (for rotational reasons recommended by agronomists). Family labor was not an explicit restriction, but all plans depended primarily on the family labor supply. Farm sizes required to meet target family incomes were determined assuming linear total revenue and total variable cost functions, but with investment per acre a decreasing function of size (economies of scale). The required farm sizes to produce target incomes in the 35,000 A$–50,000 A$ range for types (a), (b), and (c) were approximately 100, 150, and 50 hectares.

Since the owner-operators of the modern farming units would come from the traditional farming sector, their capital is limited and government loans must finance all cash expenses of the new units in their initial years—equipment purchases, annual operating expenses, and salary allowances for family consumption expenditures. However, the farming unit must repay these loans at commercial rates (short term credit at 9 percent interest; medium and long-term credit at 6 percent) within the 15-year development period in order to pass the test of financial viability (step 3). The loans include grace periods in the initial years; unpaid debts are transferred, with interest, to the following year. The cattle raising-forage-soybean farm failed the financial feasibility test (cash flows were still negative at year 15), thus limiting the analysis to the other two types of modern units (both self-financing within five to nine years).

The regional MPLP model was constructed to investigate the potential transformation of traditional into modern farming units under the 15-year government-sponsored investment project (step 4). Figure 2 shows the first two years of the MPLP coefficient matrix. The model includes three farm types—a traditional farm (X_{31}) and the two financially viable modern units (X_{41} and X_{51}). The program is constrained by land and labor resources, investment funds, and a limit on the number of milk farms imposed by limited regional demand for milk. The traditional farms demand only land and labor; the modern units demand investment funds as well. The "land transfer" activity (X_{11}) transfers land from traditional to modern units; investment funds unused in one period can also be transferred to the following year (X_{21}).

Development of modern farms will employ fewer families. The MPLP model recognizes the costs of human resource adjustments and attempts to internalize them by financing either resettlement in other colonization schemes or retirement for the displaced families. Over 60 percent of the owner-operators in the Campo exceed 50 years of age, and rapid out-migration has strongly limited the number of sons in the potential supply of future farm operators. The analysis assumed that farmers over 52 years of age whose children were not working on the farm would most likely accept the retirement alternative; if so, around 50 percent of the farmers in the 0–100 ha. category would retire if given the opportunity. Social Security would pay 300 A$ per month and the project would pay an additional 500 A$ for retirees. (Activity X_{61}, Figure 2, therefore requires an annual investment coefficient of 6,000 A$ for the expected nine-year remaining life span of retired farmers.) Families resettled in other projects would be furnished with a five-year annual income of 8,400 A$. Since the present value of retirement payments (nine years at 6,000 A$ per year) and resettlement payments (five years at 8,400 A$ per year) are approximately equal at usual in-

			YEAR 1							YEAR 2						
	Objective Function Coefficients:		C_{11}	C_{21}	C_{31}	C_{41}	C_{51}	C_{61}	C_{71}	C_{12}	C_{22}	C_{32}	C_{42}	C_{52}	C_{62}	C_{72}
	Activities:		X_{11} Land Transfer	X_{21} Capital Transfer	X_{31} Traditional Farm	X_{41} Modern Farm I	X_{51} Modern Farm II	X_{61} Unemployment Generation	X_{71} Extension requirement	X_{12} Land Transfer	X_{22} Capital Transfer	X_{32} Traditional Farm	X_{42} Modern Farm I	X_{52} Modern Farm II	X_{62} Unemployment Generation	X_{72} Extension requirement
	Resource Restraints															
YEAR 1	Land Supply	55,300	40		40											
	Land Transfer	0	—40			100	50									
	Investment Funds	2,500,000	1,060	1		87,970	47,840	6,000	5,280							
	Labor Supply	1,384			1	1	1	1								
	Extension Requirements	0				1	1		—1							
	Milk Constraint	75					1									
YEAR 2	Land Supply	55,300			—40					40		40				
	Land Transfer	0								—40			100			
	Investment Funds	2,500,000	—2,920	—1		40,050	83,450	6,000	5,280	1,060	1		87,970	47,840	6,000	5,280
	Labor Supply	1,384			1	1	1	1				1	1	1	1	
	Extension Requirements	0				1	1		—1				1	1		—1
	Milk Constraint	75					1							1		

Figure 2. Structure of the initial tableau of the MPLP model for the Apóstoles Agricultural Project

terest rates, the MPLP model was simplified by combining both retirement and resettlement into a single activity (X_{61}).

Additional extension teams required for the modern farms were estimated (by government extensionists) to consist of one agronomist and one veterinarian per 15 farms for the first four years (5,280 A$ per farm, see investment coefficient for extension activity X_{71}, Figure 2) with the ratio reduced to two technicians per 30 farms thereafter.

Sources of investment for the project consist of (a) a constant annual stream of external investment funds over 15 years by the government (set parametrically at 16 different levels in the analysis), and (b) the internal funds generated by the net return from eradicating yerba mate trees in the Campo (costing 1,060 A$ per traditional farm, see X_{11} investment coefficient, Figure 2) and transferring the quota to the Monte. An explicit feature of the proposed policy is that the more efficient farmers in the Monte will accept additions to their marketing quotas at a price equal to current production costs,[8] while the CA will sell the product at usual prices to millers, thereby generating an investable gross surplus of 2,920 A$ (see capital coefficient for year 2, activity X_{11}, Figure 2) for farm restructuring in the Campo. (The net surplus is, of course, only 2,920 A$ — 1,060 A$ = 1,860 A$.)

The purpose of the benefit-cost analysis (step 5) is to determine whether the government project can be justified at current discount rates; i.e., can the transformation to modern farming in the Campo be accomplished at a favorable marginal B/C ratio. Government costs consist of (a) purchase of capital goods, annual operating expenses, and family consumption expenditures (I_t^p) in the initial years; (b) the cost of eradicating yerba mate trees on transformed Campo farms (I_t^y); (c) retirement and resettlement payments (I_t^u); and (d) expenditures on an expanded extension service (I_t^e). Project benefits include the gross revenues from modern farming (R_t^n) and traditional farming (R_t^o) minus their respective production costs, including loan repayment (C_t^n and C_t^o). (Of course, the mix of modern and traditional farms changes annually as the transformation proceeds.) Finally, the income foregone due to project implementation (Y_t), equal to projected net farm income without the project, must be deducted. To summarize, the net benefit function ($B - C$) is as follows [see Table 1 for equations (1)–(12)]:

(13)

$$B - C = \sum_{t=0}^{T} \frac{(R_t^n + R_t^o - C_t^n - C_t^o - Y_t)}{(1+r)^t} - \frac{(I_t^p + I_t^y + I_t^u + I_t^e)}{(1+r)^t}.$$

This function is identical to the objective function of the aggregate MPLP model, except that the latter excludes Y_t, the "without project" income. Therefore,

$$B - C = \text{objective function}_{MPLP} - \sum_{t=0}^{T} y_t/(1+r)^t.$$

However, the y_t are assumed to be unaffected by the level of government expenditures. Therefore, the $B - C$ function and the objective function of the MPLP differ by only a constant, and maximization of the latter automatically maximizes the former.

Empirical evaluation of proposed policy. —The MPLP analysis at 16 levels of investment funds shows that the speed of transformation is an *increasing* function of government investment. Investment is particularly critical in the early years; therefore, increasing investment by successive constant marginal increments leads to a more than constant reduction in the number of years required for complete transformation. Since the marginal B/C ratio decreases with the level of investment, the decision problem can be posed in terms of an inverse trade-off between the marginal B/C ratio and the speed of transformation.

The empirically derived trade-offs are shown in Figure 3, for discount rates of 6, 8, and 10 percent. (While 6 percent is the prevailing rate for project evaluation in Argentina, 10 percent is clearly a more realistic rate.) The project decision makers' preference function is unknown; even the most plausible shape for indifference curves is not clear-cut. However, a reasonable statement of the project objectives may take the following lexicographic form: minimize the number of years to complete the structural transformation, given a favorable marginal B/C ratio. Figure 3 shows, for example, that if 10 percent is taken as the relevant discount rate

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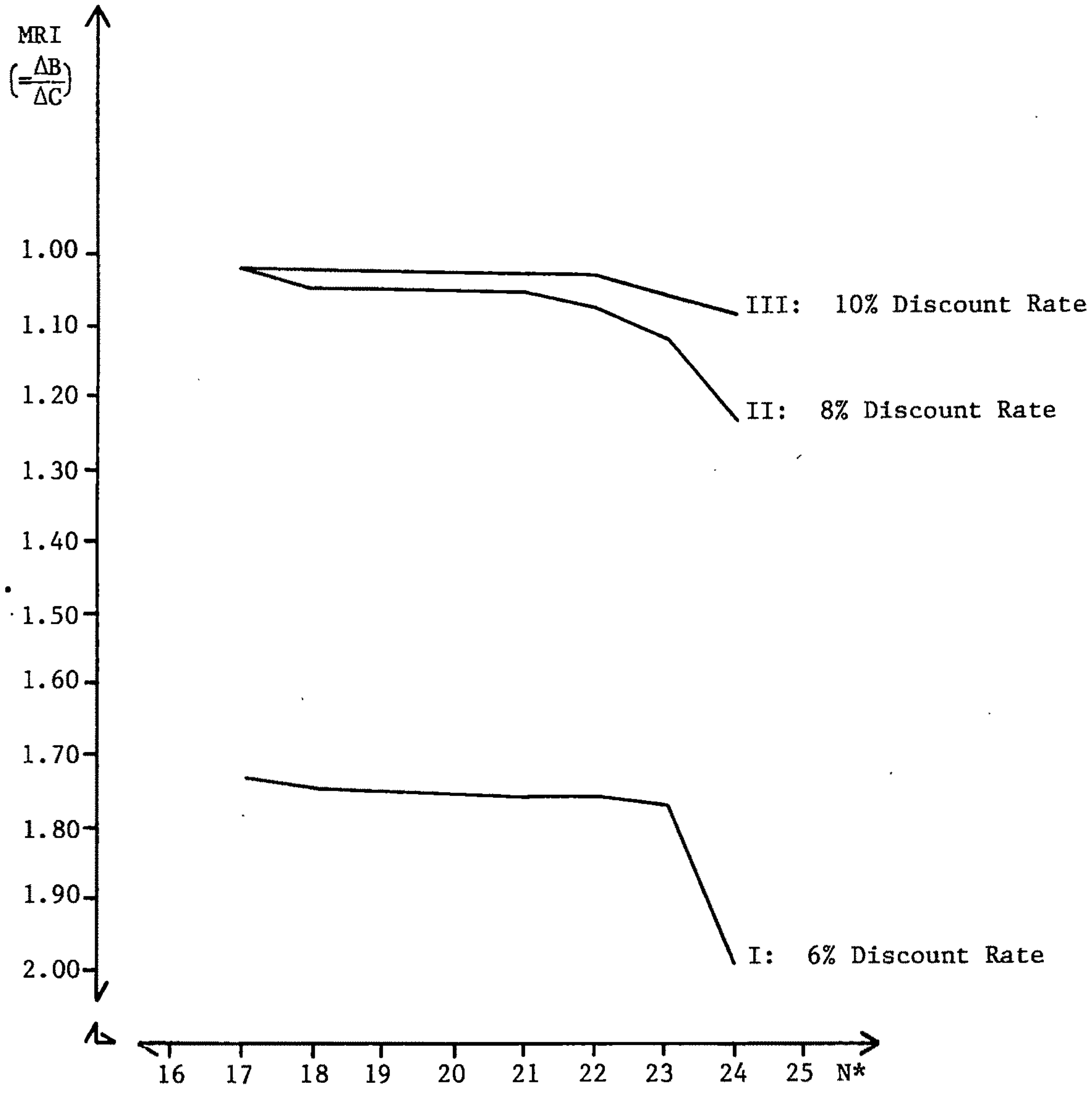
[8] Monte farmers would still increase incomes under this policy, due to economies of scale in both production and marketing. Moreover, the permanent acquisition of a larger quota puts these farmers in a position to benefit from future industry efforts to maintain or increase farm incomes.



MRI marginal returns to public expenitures

N* number of years for complete area transformation

$\frac{\Delta B}{\Delta C}$ marginal project benefits

Figure 3. Trade-off between the income and government efficiency objective, empirical estimates—Apóstoles Project

and a marginal B/C ratio $\geqslant 1.0$ is desired, then the minimum time required for complete structural transformation is about 17 years. Such a period seems short enough to insure a high regional economic impact and, at the same time, to offer sufficient time for flexibility in identifying those farmers who wish to restructure, retire, or resettle immediately versus later. Of course, if decision makers wish to incorporate a safety factor in their calculations in the form of a higher minimum marginal B/C ratio, the amount of time required for complete transformation would be increased to the point where political feasibility is debatable.

Table 2. Income distributional effects of full project implementation

		Farm Income Per Group Under the Assumption of No Action		
Farm Categories	Size Groups (Hectares)	Number of Farmers (Number)	Annual Income per Farmer[a] (A$)	Total Income per Size Bracket (A$)
Traditional Farms	0–5	137	150	20,550
	5–10	68	450	30,600
	10–25	523	1,050	549,150
	25–50	492	2,250	1,107,000
	50–75	24	3,750	90,000
	75–100	140	5,250	735,000
	Total <100	1,384		2,532,300
		Farm Income Under the Assumption of Project Implementation		
Modern Farms	Resettled or Retired Farmers	799	9,600	7,670,400
	Beef-Soybean Farms	510	38,120	19,441,200
	Dairy Soybean Farms	75	48,745	3,655,875
	Total	1,384		30,767,475

[a] This assumes an average of 60 A$ per ha. per year and farm size at mid-point of range.

Table 2 shows the income distribution effects of full project implementation. Regional income to small farmers increases more than 10 times, from about 2,500,000 A$ to 30,000,000 A$ per year. Also, no family is estimated to be worse off under full project implementation, since the annual income (9,600 A$) for retired or resettled farmers is higher than the estimated annual income (5,250 A$) for the largest size bracket (75 to 100ha.) of traditional farms. Over half the population of 1,384 small farmers is resettled or retired under the project. An alternative worth further investigation would be to examine the impact of reducing the size of the modern units, thereby increasing the number of families employed at more modest (but still improved) income levels and reducing the number of retired and resettled farmers.

Conclusions

Financial analysis of the project reveals that about 25 percent of the project investment is generated internally from the CA net surplus earned on yerba mate allotments transferred from the Campo to the Monte. The remainder is financed by government investment at (as shown) a favorable marginal *B/C* ratio with discount rates as high as 10 percent.

A second method of financing would be to increase sharply an existing, but nominal, *ad valorem* tax on millers. It was estimated [3] that the entire required project investment could be generated by an 8 percent *ad valorem* tax. Given the structure of the industry, it is likely that this tax would be passed along to the consumers of yerba mate and, because of inelastic demand, with little effect on quantities produced and handled. From a political viewpoint, this method is probably more attractive since it requires no government funds. From a welfare point of view, however, raising the required investment funds through the government via the income tax is less regressive than taxing yerba mate consumers directly through higher prices. But, since yerba mate purchases are an insignificant proportion of total consumer expenditures, even for confirmed users in low income strata, the welfare effects of higher consumer prices could probably safely be ignored.

To summarize, the yerba mate industry provides another example of a world-wide phenomenon—price policies designed to defend the agricultural sector, but which work to the disadvantage of the poor within agriculture. In addition, the government price policy in the case of yerba mate has become a mechanism for further discrimination against the poor by more powerful agricultural interests. It is concluded that changes in agricultural land holdings and production structure must form the core of any realistic attempt to deal with the small farm poverty problem. The authors have analyzed one such proposal which appears to be economically feasible and with good prospects for political support.

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Short Articles and Notes

Risk, Learning, and the Adoption of Fertilizer Responsive Seed Varieties*

L. DEAN HIEBERT

The effect of uncertainty due to imperfect information on the decision to adopt fertilizer responsive seed varieties is examined. Additional information and enhanced ability to "decode" information are shown to increase the likelihood of adoption. Relevant empirical evidence for the Philippines is summarized.

Key words: **risk; learning; adoption; stochastic dominance.**

SEVERAL economic models of diffusion have allowed for the possibility of allocative error or have emphasized the accumulation of knowledge during the adoption process [3, 10, 12]. This implies that, initially, decision makers do not know everything that matters. Viewed from this perspective, the adoption decision is a decision problem under uncertainty. The decision makers have different and incomplete information about the characteristics of new and improved inputs and hence could properly be said to be uncertain about them. As the innovation process proceeds, decision makers obtain additional information which, if new and relevant, reduces uncertainty and hence the possibility of making allocative mistakes. Therefore, it is important to introduce experience explicitly into an uncertainty model of the adoption process.

The purpose of this paper is to examine the effect of "learning" under uncertainty on the decision to adopt fertilizer responsive seed varieties. "Learning" is interpreted to mean gaining more information about the probability distribution of output which reduces the possibility of allocative error. As the stock of information increases, uncertainty about relevant variables is reduced so that, in the limit, all uncertainty due to imperfect information is effectively eliminated. This implies that skills which enable the recipient to "decode" information are more important the more dynamic the economy and is consistent with the analyses of Nelson and Phelps [12], Welch [14], and Kislev and Shchori-Bachrach [10].

Several writers have examined the consequences of uncertainty for optimal levels of fertilization [1, 4]. The contributions of these authors have the feature that the outcome of a fertilization decision depends upon the (uncontrollable) "state of the environment," expressed as a random variable unknown at the time of the decision but governed by a known probability distribution. With that approach no circumstances for learning can arise. In the approach presented here, the state of the environment includes an "informational state" which changes as experience accumulates.

In the next section a model of the adoption of high yielding seed varieties is presented. Then the consequences of learning for the adoption decision are examined. Finally, relevant empirical evidence for the Philippines is summarized.

A Model of New Seed Adoption

Production with new seed varieties is assumed to require a modern input, e.g., chemical fertilizer, and land.[1] Suppose that with high yielding seed varieties the yield response to fertilizer has increased However, the farmer is uncertain about the precise change in the response. Therefore, let the output obtained from "modern" production be given by[2]

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[1] For notational simplicity inputs other than land and fertilizer are ignored. Other inputs can be included, but the analysis becomes much more cumbersome without adding insight.

[2] For example, a Cobb-Douglas function might be specified, $q = \beta N^{\alpha} Z^{(1-\alpha)}$, where β is a random variable and α is a fixed parameter but is subjectively random in the Bayesian sense. The present analysis could be extended to

$$q^* = f^*(N(\alpha),Z,\beta) \tag{1}$$

where f^* is a strictly concave function, N denotes fertilizer input, Z denotes land input, α is a fixed parameter which is subjectively random in the Bayesian sense, and β represents the "state of nature."

The farmer has the option to farm part of his land with the new technology and the remainder with the old technology. Traditional production is performed without fertilizer according to the strictly concave production function[3]

$$q = f(Z,\beta). \tag{2}$$

For simplicity the output produced according to both technologies is assumed to be homogeneous.

The total output obtained by the farmer is

$$q = f^*(N(\alpha),Z,\beta) + f(\bar{Z} - Z,\beta) \tag{3}$$

where Z is the amount of land devoted to modern production and $\bar{Z}$ is total available land. α and β are assumed to possess a joint probability density function distributed independently of the input levels. It is further assumed that, given input levels, larger values of the random variables are associated with larger values of the output from each method of production. This implies that returns (conditional on α) to modern and traditional production are positively correlated. For example, an increase in rainfall increases output according to both technologies. In addition, it is assumed that, given input levels, larger values of the random variables are associated with larger values of the marginal products, $\partial q/\partial N$ and $\partial q/\partial Z$. This implies that the dispersion of output increases as the input levels increase (and hence as expected output increases).[4] Although it appears plausible to assume that the dispersion of total output increases as more fertilizer or more land is devoted to modern production, it should be emphasized that the results obtained in this section depend critically on this assumption.[5]

The net income of the farmer is

$$\pi = pf^*(N(\alpha),Z,\beta) + pf(\bar{Z} - Z,\beta) - cN \tag{4}$$

where p is commodity price and c is the price of fertilizer. Assume that the farmer knows with certainty the output price which will prevail at the end of the production period (because of, for example, a price stabilization scheme). Since the production functions contain random variables, the farmer's net income is stochastic. The farmer is assumed to choose input levels at the beginning of the period in order to maximize the expected utility of net income received at the end of the period:

$$E[U(\pi)] = E[U(pf^*(N(\alpha),Z,\beta) + pf(\bar{Z} - Z,\beta) - cN)]. \tag{5}$$

The first order necessary conditions for a maximum are[6]

$$E[U' \cdot (pf^*_n - c)] \leqslant 0 \tag{6}$$

$$E[U' \cdot (pf^*_z - pf')] \leqslant 0 \tag{7}$$

with the inequality holding in (6) when no fertilizer is used and the inequality holding in (7) when no land is devoted to modern production. If no modern production is undertaken, this implies that

$$E[U(pf(\bar{Z},\beta))] > E[U(pf^*(N^*(\alpha),Z,\beta) + pf(\bar{Z} - Z,\beta) - cN^*)]$$

for N^* satisfying (6) and $Z > 0$. The expected utility of income when all land is used in traditional production exceeds the expected utility of income when some modern production is undertaken, and a boundary solution is obtained. Note that if $Z = \bar{Z}$ at the optimum, then no traditional production is undertaken and the following analysis applies to the problem of choosing an optimum level of fertilization.

If some modern production is undertaken, then conditions (6) and (7) hold as equalities, and the optimum levels of the inputs depend upon the farmer's attitude toward risk.[7] The risk neutral producer, for whom U' is a positive constant, determines N by equating the expected marginal value product of fertilizer to its price and determines Z by equating the expected marginal value product of land in both kinds of production:

$$E[pf^*_n] - c = 0 \tag{8}$$

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include the case where α is stochastic with unknown parameters.

[3] Again, for simplicity other inputs are ignored.

[4] To show this, write the variance of output as $E[q^2] - (E[q])^2$ and differentiate with respect to N:

$$\partial \mathrm{Var}[q]/\partial N = 2E[q \cdot \partial q/\partial N] - 2E[q]E[\partial q/\partial N] = 2\mathrm{Cov}[q,\partial q/\partial N] > 0.$$

The result for Z is similarly shown.

[5] This assumption is suggested by data on the response of crop yield to fertilizer. See, for example, [1, 5].

[6] The second order conditions are assumed to be satisfied. A sufficient condition for their satisfaction is that the farm firm be risk neutral ($U'' = 0$) or risk averse ($U'' < 0$).

[7] This is an empirically interesting case. Tagumpay-Castillo [13] reports that in the Philippines both traditional and new varieties were planted by most farmers in the period immediately following adoption.

$$(9) \qquad E[pf^*_z] - E[pf'] = 0.$$

If the utility function is not linear, then it can be shown that

$$(10) \quad E[U' \cdot (pf^*_n - c)]/EU' \gtreqless E[pf^*_n] - c$$

and

$$(11) \quad E[U' \cdot (pf^*_z - pf')]/EU' \gtreqless E[pf^*_z] - E[pf']$$

as the producer has a preference for risk ($U''' > 0$) or is risk averse ($U'' < 0$).[8] Assuming that the inputs are stochastic complements ($EU_{nz} = EU_{zn} \geqslant 0$), this implies that the risk preferring farmer will use more land and more fertilizer in modern production than the risk neutral farmer, while the risk averting producer will use less land and less fertilizer in modern production than the risk neutral producer. The interpretation of this result is clear. The risk averse producer stops short of maximizing expected net income because the variance of net income increases as expected net income increases. Similarly, the risk preferring producer chooses input levels such that the variance of income is greater than is obtained by maximizing expected net income.[9]

Learning and Adoption

Welch [14] postulates that producers make allocative errors. In the context of the present model, one reason for allocative error is that producers are mistaken about the true values of certain parameters of the production function. A natural interpretation of "learning" is gaining additional information about the unknown parameters which reduces the likelihood of allocative mistakes. As the producer gains additional information about the unknown parameters, the producer adjusts his input levels so that the probabilities are redistributed from lower payoffs to higher payoffs. Formally, the probability (conditional on the chosen input levels) of obtaining net income from modern production of π^* or less decreases as learning occurs. Alternatively, the probability (conditional on the chosen input levels) of receiving net income from modern production greater than π^* increases as learning occurs. Consequently, the effect of learning is represented by a rightward shift in the conditional distribution function of net income from modern production such that

$$F(\pi^* | N^*, Z^*, \beta) > F^*(\pi^* | N^{**}, Z^{**}, \beta)$$

for all π^*, where F is the distribution function given the original stock of information, F^* is the distribution function after gaining additional information, N^* and Z^* are the optimal input levels given the original stock of information, and N^{**} and Z^{**} are the optimal input levels after additional information is received. In the terminology of stochastic dominance [7, 8], the distribution function F^* dominates the distribution function F in the first degree.

Differences in information among producers imply differences in adoption behavior in the present model. It has been shown that some modern production will be undertaken only if

$$E[U(pf^*(N^*(\alpha), Z^*, \beta) + pf(\bar{Z} - Z^*, \beta) - cN^*)] > E[U(pf(\bar{Z}, \beta))]$$

Hadar and Russell [7] and Hanoch and Levy [8] have shown that a rightward shift in the distribution function of net income from modern production (in the sense of first degree stochastic dominance) implies an increase in the expected utility of income due to modern production.[10] Suppose that attitudes toward risk are randomly distributed over the population of farm producers. Then, *ceteris paribus*, the probability that a randomly chosen firm will be an adopter increases as the stock of information pertaining to modern production increases. Furthermore, different producers have different abilities to "decode" and analyze the information received so that producer skills are important in the adoption process. Hence, *ceteris paribus*, the probability that a randomly chosen firm will be an adopter increases as producer skill increases. The importance of producer skills in the adoption process has been emphasized by Nelson and Phelps [12], Welch [14], and Kislev and Shchori-Bachrach [10]. Note that these results hold for any monotone

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[8] To obtain this result, note that determining the sign of

$$E[U' \cdot (pf^*_n - c]/EU' - (E[pf^*_n] - c)$$

is equivalent to determining the sign of $\mathrm{Cov}(U', pf^*_n)$. Since f^* and f^*_n are both increasing functions of α and β, the covariance expression is positive or negative as $U''' \gtreqless 0$.

[9] The appropriate specification of the attitude toward risk of the farm firm remains an open question. Most observers feel that the Asian farmer is risk averse. For some evidence that Asian farmers are risk averse, see Behrman [2] and Hiebert [9].

[10] If some modern production is undertaken, learning causes the optimal levels of the inputs to increase if $U' \cdot \pi_n$ and $U' \cdot \pi_z$ are increasing functions of the random variables, by the results of Hadar and Russell [7] and Hanoch and Levy [8].

increasing utility function and thus are not due to the attitude toward risk reflected by the utility function.

The likelihood of adoption can also be expected to depend upon the physical environment of the farmer. A more favorable environment increases the expected utility of net income (or the utility of the certainty equivalent net income) from modern production and hence, *ceteris paribus,* increases the probability that a randomly selected firm will be an adopting firm. This result is in agreement with the empirical study by Griliches [6] showing that the rate of adoption is positively related to the profitability of adoption.

Relevant Empirical Evidence

When new seed varieties are introduced, the farmer must acquire information concerning how to utilize new methods effectively. For example, the new seed varieties may be more disease prone and more attractive to birds, insects, and rodents, requiring that the farmer discover appropriate practices to control pests and protect from disease. In addition, the application of large amounts of fertilizer to short-stalked high yielding varieties of rice without a simultaneous change in weed control practices may result in an increased probability of low yields, since weed growth encouraged by the high fertilizer levels may diminish the sunlight received by the rice plant. Hence, during the period of learning, allocative errors may be large.

On the basis of the previous analysis one expects farmer skills, information transmitting activities, and physical environment to be important determinants of the likelihood of adoption of high yielding seed varieties. These conclusions are consistent with the evidence concerning the adoption of high yielding rice varieties by Philippine farmers.[11]

Consider first the pattern of seasonal adoption. There is some evidence to indicate that if good water control is available in the dry season, then the mean yield is larger and the variance of the yield is smaller in the dry season than in the wet season (when levels of solar radiation are more variable because of variable cloud cover and when typhoons, floods, and droughts can occur). For the special case of mean-variance analysis, it is well known that a larger mean and a smaller variance is a sufficient condition for dominance. Hence, *ceteris paribus,* one would expect the likelihood of adoption to be larger in the dry season than in the wet season. Tagumpay-Castillo [13] found that when adequate dry season water is available, the proportion of farmers planting new varieties was higher in the dry season than in the wet season. Mangahas [11] reported similar findings. He estimated linear probability functions for the use of high yielding rice varieties by Philippine farmers in Central Luzon. His results indicate that the probability of adopting a high yielding variety is greater for irrigated farms than for rainfed farms and that, when irrigation is available in both wet and dry seasons, the probability of adoption is greater in the dry season than in the wet season.

However, the most interesting results reported by Mangahas concern the role of farmer skills and information in the diffusion process. Certain farmers in his sample had been selected by the agricultural extension service for intensive assistance. In addition, Mangahas constructed an index of farmer "expertise" or experience based upon the farmer's use of recommended rice cultivation practices. He found that the probability of adoption of new varieties was positively related to the level of expertise and to the level of extension assistance. Furthermore, recipients of intensive extension assistance also had consistently higher levels of expertise. The latter result indicates, perhaps, that farmers with greater skills have a greater incentive to acquire additional information.[12] Finally, in contrast to the results of Welch [14] and Chaudhri [3], the level of schooling had little effect on the probability of new variety use. This result may be due to the fact that few farmers had completed more than five years of schooling.

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[11] The evidence cited for the adoption of new rice varieties refers to the first crop year of importance, 1967/68. In 1966 the government support price for rice was raised from 12 pesos/45kg to 16 pesos/45kg of paddy, and in 1967/68 the government purchased a large amount of rice and stored much of it. Price support funds, however, have tended to be somewhat uncertain. See [11].

[12] In contrast, Welch found that extension activities were not an important determinant of the relative productivity of skilled producers.

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Strategy For Pesticide Use: Frequency and Applications*

HOVAV TALPAZ AND ITSHAK BOROSH

A pest control model with multiple treatments is presented. Population dynamics and damage rates are temperature dependent with predation affected by pesticide application. Pesticide tolerance distribution is used for constructing the estimated kill function. Mathematical-numerical optimization is applied, selecting frequency and dosage which minimize control costs and crop damage.

Key words: **pest control; kill function; numerical optimization; population dynamics; multiple treatments.**

THE APPLICATION of pesticides as a means of pest control is becoming an increasingly more important issue and, hence, is attracting more attention of economists [3, 5, 8, 9, 10, and 14]. Pollution aspects, reinforced by the current "energy crisis" which will undoubtedly boost the price of pesticides, add more dimensions to the widespread use of pesticides. There are good reasons to believe that farmers overuse pesticides as a means of insurance against pest damages [1, p. 1]. In a situation of uncertainty, their practice could very well be the right strategy for the individual producer. But, as scientists improve the pest damage prediction, it becomes crucially important to calculate the insurance-free control cost, allowing for better management or maybe a design of monetary insurance schemes for the benefit of society.

J. C. Headley has defined the term "economic threshold" as measuring the pest population levels at which controls should be initiated [9]. Within the framework of a single pest population growth model and a single application of a pesticide, the model relates crop damage in dollars to pest density and time. Two important variables, timing and quantity of pesticide, are not adequately treated in Headley's model, and significant improvement can be found in Hall and Norgaard's model [8]. They considered two control variables, timing and quantity of a single pesticide application. The profit was maximized by a suitable choice of the control variables.

However, as pointed out in [2], the Hall and Norgaard model yields a boundary trivial solution in the case where the insect mortality rate from the insecticide is independent of the size of the pest population. This assumption is widely used ([10, 12, 15], for example).

In practice the producers often apply multiple treatments throughout the crop season. A setup cost, independent of the quantity of pesticide used, is involved for each treatment. The setup cost usually includes preparation costs and fixed contract fees which are strictly proportional to the number of treatments and do not depend on the quantity of pesticide applied. In the case of a single treatment, the setup cost does not affect the optimal solution, and, therefore, it was not taken into account in the Hall and Norgaard model [8]. Multiple treatment models were considered in Chatterjee [6] and Hueth and Regev [10]. In Chatterjee, however, the cost of application of pesticide is considered as independent of the survival rate desired. In both of these papers, a method of solution is indicated; however, the functions involved are not explicit and no numerical computations are carried out. Chatterjee's model takes into consideration a constant rate of immigration v. However, his method seems not to work in case $v = 0$ or v is very small [16, pp. 732–733]. The following model represents an attempt to incorporate multiple treatment and setup cost. An APL computer program was written for the mathematical model using an explicit efficiency kill function.[1] The results of a partial sensitivity analysis conducted on the model are given.

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[1] The computer algorithm is available from the authors.

Model Formulation

The model assumes a single field crop and a single pest population. Since pest population growth and pest damage rate depend on the temperature, many investigators have found it useful to measure the time in degree-days ([11], for example). The number of degree-days in a given period is obtained by integrating the excess of the temperature over a minimum threshold temperature, depending on the pest. In this paper, the time will be measured in "physiological day" units. Each unit is equal to the average number of degree-days per calendar day during the crop season.

The pest control is achieved by an unspecified number of treatments with a particular pesticide at equal physiological time intervals. Once the temperature distribution over the crop season is known, the "physiological time" intervals can be converted into calendar time intervals whose length will vary according to the prevailing temperature, and the treatment schedule can be obtained. The term "time" used here will refer to physiological time.

Pest population dynamics

The population level at any point of time depends not only on the growth process but also on the effect of the control action. A simple homogeneous birth-death process without migration is assumed. If the birth and death rates are respectively denoted by v and μ, then the growth rate is

$$\rho = v - \mu; \qquad \rho > 0, \tag{1}$$

and the population level satisfies the differential equation

$$dP = \rho P dt \tag{2}$$

which gives the population level at physiological time t

$$P(t) = P_o e^{\rho t} \tag{3}$$

where P_o is the initial population level.

For more flexibility of the model, a new rate of growth r is assumed after the first pesticide application. Such a situation may occur, for example, if some biological control exists in the form of natural predators or parasites. In such a case the control is mostly eliminated with the first pesticide application leading to a lower pest mortality rate and, therefore, $r > \rho$.

Let T denote the total time for the control program in physiological days, $t_o = 0$ the beginning time, and T the harvest time. Assume $(n - 1)$ treatments are applied at the times T/n, $2T/n$, $\ldots$, $(n - 1)T/n$. Let ζ be the pest survival rate after the first application of the pesticide, and Z the pest survival rate for any subsequent treatment. The pest population level at time t is given by

$$P(t) = \begin{cases} P_o e^{\rho t} & t_o \leqslant t < T/n \\ \zeta Z^{i-1} P_o e^{\rho T/n} e^{r(t-T/n)} & iT/n < t < (i+1)T/n \end{cases} \tag{4}$$

$$\text{for } i = 1, \ldots, (n-1).$$

The mathematical procedure is considerably simplified by assuming that the pest population level is reduced to the same level after each treatment. This implies

$$\begin{aligned} \zeta P_o e^{\rho T/n} &= P(T/n + 0) = P(2T/n + 0) \\ &= \zeta Z P_o e^{\rho T/n} e^{rT/n} \end{aligned} \tag{5}$$

yielding

$$Z = e^{-rT/n}. \tag{6}$$

The pest population dynamics is illustrated in Figure 1 for $n = 4$.

The control variables will be ζ and n, and they will be selected to maximize the profit. The quantity X of pesticide to be used will be a function of ζ or Z and depends on the choice of the kill efficiency function.

Kill efficiency function

It is widely accepted [10, 12, 15] that the amount of $K(X,t)$ of pests killed by the application of the amount X of pesticide at time t is linearly related to the pest level and increases with the amount of pesticide used:

$$K(X,t) = P(t)\, F(X). \tag{7}$$

$F(X)$ is the kill efficiency function and is generally assumed to be monotonously increasing with X at an increasing rate for low levels of X and at a decreasing rate for high levels of X. $F(X)$ also satisfies the boundary conditions

$$F(0) = 0 \tag{8}$$

$$\lim_{X \to \infty} F(X) \leqslant 1 \tag{9}$$

A theoretical study of the dose-response relationship is carried in Finney [7], based on a hypothetical distribution of the pest tolerance to the given pesticide; this yields a sigmoid shaped curve satisfying (8) and (9). Several sigmoid

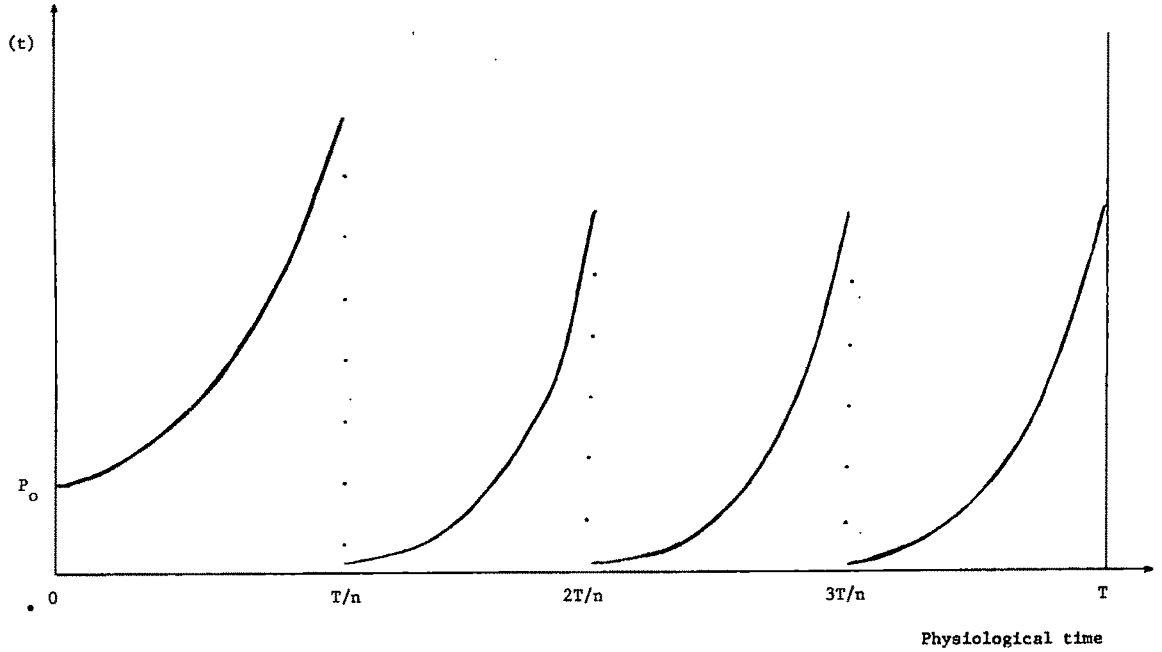

Figure 1. Pest population dynamics subject to pesticide applications

shaped explicit functions have been fit to dose-response data (Arctg function, logistic function). However, the logistic function used by Shoemaker [15], for example, does not satisfy (8) and, therefore, is not suitable for small doses. For this study the function[2]

$$F(X) = 1 - e^{-ax^{\lambda}} \tag{10}$$

with parameters a and λ has been selected. It satisfies the previous conditions provided $\lambda > 1$. Figure 2 shows the behavior of such a kill function. It can be seen that the curve has an inflection point at $X = ((\lambda - 1)/a\lambda)^{1/\lambda}$. At the inflection point the survival rate is $e^{(1-\lambda)/\lambda}$.

The pest damage function

It is assumed that the damage caused to the crop by each insect per physiological day throughout the season has a constant value δ. The damage caused by the pest population in the interval between t_1 and t_2 is given, therefore, by

$$D(t_1, t_2) = \int_{t_1}^{t_2} \delta P(t)dt. \tag{11}$$

Let $D_i = D(iT/n, (i+1)T/n),$

$i = 0, \ldots, (n-1).$

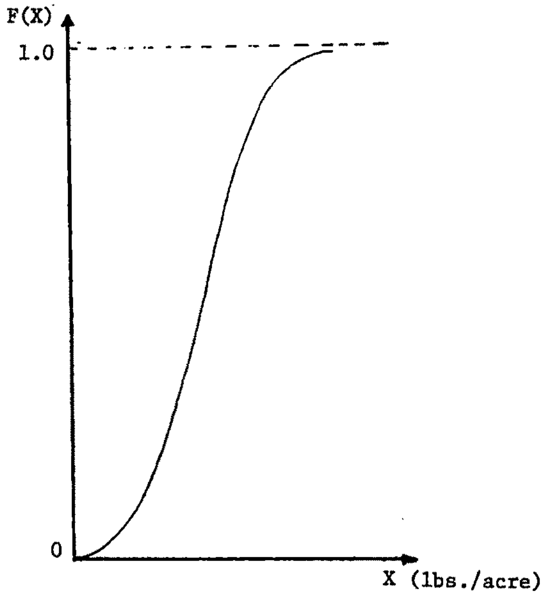

Figure 2. The kill efficiency vs. pesticide dosage function $F(X) = 1 - e^{-aX^{\lambda}}$

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[2] The kill function selected can be derived by assuming that the insect tolerance to the pesticide dose has the Weibul distribution [16, p. 319] given by:

$$G(X) = \begin{cases} 1 - e^{-(bX)^{\lambda}} & \text{for } X \geqslant 0 \\ 0 & \text{for } X < 0 \end{cases}$$

whose density is given by:

$$g(X) = (b\lambda)(bx)^{\lambda-1} e^{-(bX)^{\lambda}}.$$

The insects killed by the application of the dose X of pesticide are those whose tolerance is not greater than x, therefore the kill rate is given by:

$$F(X) = G(X) = 1 - e^{-aX^{\lambda}} \quad \text{when } a = b^{\lambda}.$$

Then

$$(12)\qquad D_1 = \frac{\delta P_o}{\rho}\,(e^{\rho T/n} - 1)$$

$$(13)\qquad D_2 = \ldots = D_n = \frac{\delta \zeta P_o e^{\rho T/n}}{r}\,(e^{rT/n} - 1) = D';$$

therefore, the total damage is

$$(14)\qquad D = D_1 + (n-1)D'.$$

Notice that D is proportional to the area under the curve in Figure 1.

The pesticide cost function

The cost for an application of the quantity X of pesticide is given by

$$(15)\qquad S(X) = \begin{cases} C + \alpha X & \text{if } X > 0 \\ 0 & \text{if } X = 0 \end{cases}$$

where C is the setup cost per treatment and α denotes the unit cost of pesticide X, where X is a function of the survival rate and can be obtained by solving (10).

The profit function

Let β^* denote the unit crop product price, γ the harvest cost per unit, and $\beta = \beta^* - \gamma$. Let y be the pest-free crop yield, then the total profit π is given by

$$(16)\qquad \pi(\zeta,n) = \beta^* y - (n-1)C - \alpha\,[X(\zeta) + (n-2)X(Z)] - \beta D$$

where $X(\zeta)$ and $X(Z)$ are the quantities of pesticides applied at the first treatment and the subsequent treatments, respectively.

The Solution Method

One of the control variables ζ is continuous while the second one, n, is discrete. This suggests two methods of solution.

The discrete method

From the practical point of view, this is the only valid solution because n must be an integer according to the model specifications. For each feasible n, an optimal ζ is selected to maximize $\pi(\zeta, n)$. Such a ζ satisfies

$$(17)\qquad \pi_\zeta(\zeta, n) = 0$$

$$(18)\qquad \pi_{\zeta\zeta}(\zeta, n) < 0.$$

The feasible n for which the corresponding optimal ζ yields maximal profit will give the required solution.

Equation (17) is solved by the Newton-Raphson method [4, p. 319]. When T is not too large, this direct search for the optimal n should not be too costly to perform.

The continuous method

The control variables ζ and n are both considered as continuous, and an optimal pair (ζ, n) is found such that $\pi(\zeta, n)$ is maximum. The optimal pair (ζ, n) may not be feasible since n may not be an integer. However, this method can be of interest since it generally yields a solution close to the discrete solution, and, in addition, it is more sensitive to changes in the model parameter values, making it easier to understand and interpret the direction of changes of the optimal solution while conducting a sensitivity analysis for the model.

The optimal pair (ζ, n) is found by solving, using the Newton-Raphson method, the system:

$$(19)\qquad \pi_\zeta(\zeta,n) = \frac{\beta d P_o}{r}(n-1)\,e^{\rho T/n}(1 - e^{rT/n}) + \frac{\alpha a}{\lambda\zeta}\left(-\frac{\log\zeta}{a}\right)^{1/\lambda - 1} = 0$$

$$(20)\qquad \pi_n(\zeta,n) = \frac{\beta d P_o}{r}\,e^{\rho T/n}\left\{\zeta(1 - e^{rT/n}) - \frac{T}{n^2}\,[r + \zeta(n-1)\,(\rho + e^{rT/n}[\rho + r])]\right\} - C - \alpha\left(\frac{rT}{na}\right)^{1/\lambda}\left(1 - \frac{n-2}{\lambda n}\right) = 0,$$

and checking for the solution, the second-order conditions

$$(21)\qquad \pi_{\zeta\zeta} < 0; \qquad \pi_{nn} < 0; \qquad \pi_{\zeta\zeta}\pi_{nn} - (\pi_{\zeta n})^2 > 0.$$

A Numerical Illustration: Insect-Cotton Control System

The above model was applied to a semi-realistic cotton system. Some of the results are discussed below.

The following values were assigned to the parameters:

Cotton growing period: $T = 180$ physiological days.

Rates of insect population growth: $\rho = 0.01$, $r = 0.05$.
Initial insect population level: $P_o = 1000$ per acre.
Damage rate per insect per day: $\delta = 0.001$.
Price of pesticide: $\alpha = \$1.5$ per pound active ingredients.
Setup cost: $C = \$3$ per acre per treatment.
Cotton price: $\beta = \$0.70$ per pound at the farm level.
The parameters for kill efficiency function were estimated: $a = 1.044$, $\lambda = 1.025$.[3]

For these particular values of the parameters, the discrete method gave the solution $\zeta = 0.0046$, $n = 7$ with a total cost of \$56.46 per acre (\$34.59 pesticide application cost and \$21.87 crop damage value). The profit was not calculated since there was no need to assign any value to the damage-free crop yield. The corresponding quantities of pesticide were 4.93 pounds per acre for the first treatment and 1.23 pounds per acre for the subsequent treatments. The continuous method gave $\zeta = 0.0047$, $n = 6.94$, a total cost of \$56.45 per acre (\$34.36 for pesticide application and \$22.09 for crop damage value), and quantities of pesticide of 4.94 pounds per acre for the first treatment and 1.24 pounds per acre for the subsequent treatments.[4] Note that, as could be expected, the continuous method yielded a solution with only a slightly lower cost than the discrete method.

Partial Sensitivity Analysis

In order to evaluate the model sensitivity to changes of a few of its economic and biological parameters, the following parameters were selected for the analysis: α, β, C, and r, to be varied one at a time while keeping all other parameters fixed at the values assigned above. The analysis was carried out by using the nondiscrete solutions which, as already noted, are more sensitive to changes and provide a better understanding of the trends. The results are summarized in graph form (Figures 3, 4, 5, 6, and 7). The graphs were plotted directly by the computer.

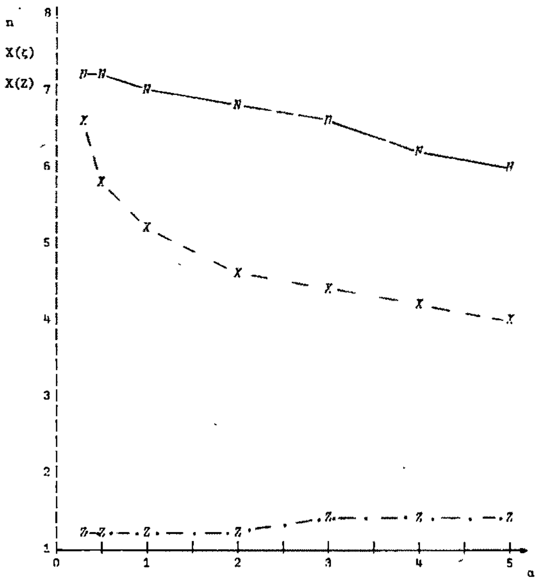

Figure 3. Optimum levels of n, $X(\zeta)$, and $X(Z)$ for given levels of pesticide price α

* n in number units is expressed by the N-curve. $X(\zeta)$ and $X(Z)$ in pounds per acre units are expressed by the X-curve and Z-curve, respectively. (The same notations are used in Figures 5, 6, and 7.)

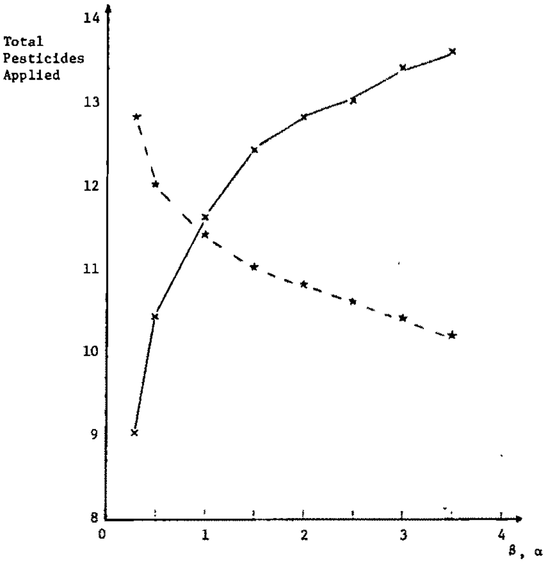

Figure 4. Total pesticide applied as a function of cotton price (solid line) and of pesticide price (broken line)

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[3] Using experimental data for measuring the effect of Methyl-Parathion on the Tobacco Budworm larvae in the cotton field [13, p. 17], the parameters a and λ have been estimated. By transforming (10) we get

$$\log[-\log(1 - F(X)] = \log a + \lambda \log X + E.$$

Assuming E is $\sim N(0, \sigma^2)$, ordinary least square method was applied, yielding $\hat{a}$, $\hat{\lambda}$ with $R^2 = .9606$, F-value $= 121.79$, and Durbin-Watson statistic $= 1.57$ with 5 degrees of freedom.

[4] The value of the survival rate corresponding to the inflection point of (10) is 0.98 ($= e^{(1-\lambda)/\lambda}$). Throughout the sensitivity analysis discussed in the next section, all the values of ζ and Z for the optimum solution were smaller than this value. This is in agreement with the usual requirement of utilizing the pesticide in the "Stage II" of its efficiency kill function.

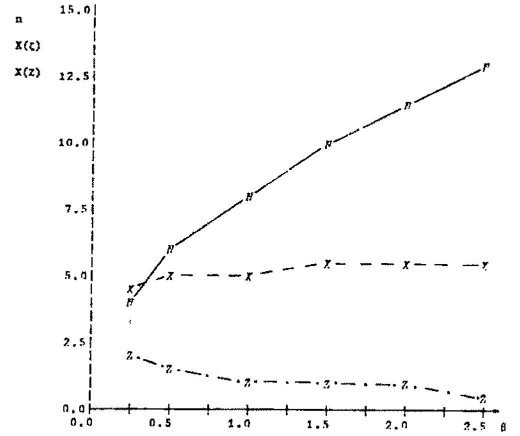

Figure 5. Optimum levels of *n*, *X(ζ)*, and *X(Z)* for given levels of cotton price *β*

Change in pesticide price *α*

Figure 3 shows that the optimal number of treatments $(n-1)$ decreases as the price of pesticide increases. $X(\zeta)$ is more sensitive, and its decline is even steeper. $X(Z)$ is slightly increased due to its relationship with n in equation (6). However, the total amount of pesticide used decreases as shown in Figure 4.

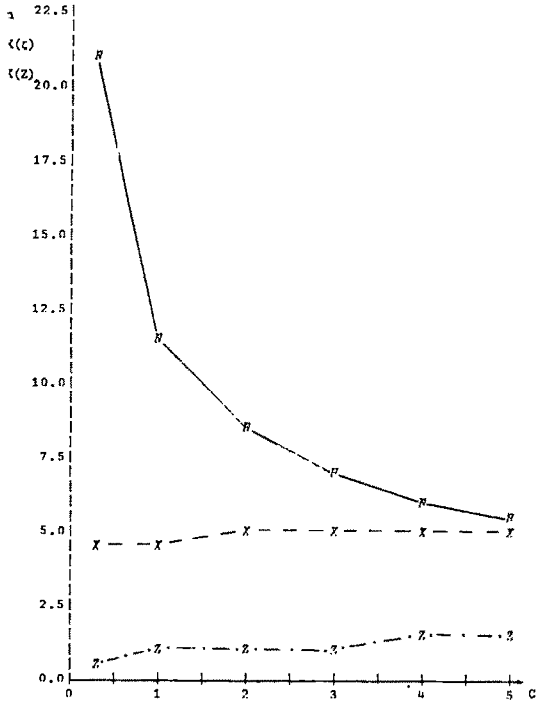

Figure 6. Optimum levels of *n*, *X(ζ)*, and *X(Z)* for given levels of setup cost *C*

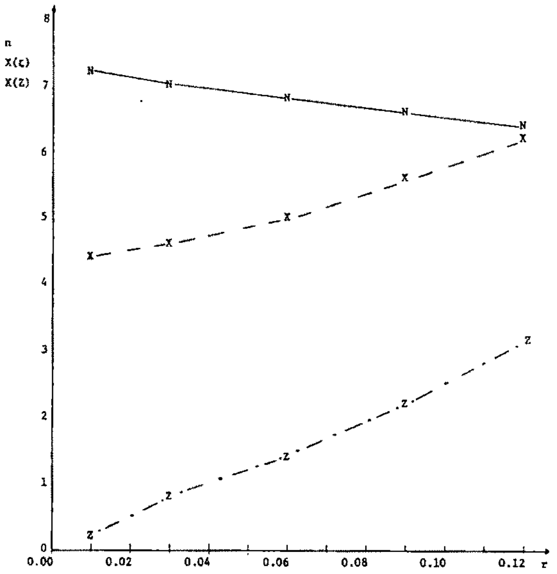

Figure 7. Optimum levels of *n*, *X(ζ)*, and *X(Z)* for given levels of *r* (population growth rate after the first treatment) with $\rho = 0.01$

Change in cotton price *β*

Figure 5 shows that n increases sharply and $X(\zeta)$ only moderately increases as the cotton price β increases. $X(Z)$ decreases with the increase of β. It should be noted that the low sensitivity upward of $X(\zeta)$ is due mainly to the relatively large dosage already applied, yielding low additional kill rates. The total amount of pesticide increases as the cotton price β increases (Fig. 4).

Change in setup cost *C*

Figure 5 shows that n decreases sharply at low values of C and decreases at a lower rate for higher values of C. $X(\zeta)$ is increasing somewhat in order to compensate for the reduction in n by preserving the cotton value in the field.

Change in the population growth rate *r*

Figure 6 shows that $X(\zeta)$ and $X(Z)$ increase with the increase of r, where n decreases simply because the larger dosages eliminate higher population levels making it possible to save C's by reducing the number of treatments. Note that only r was changed, where ρ was kept fixed.

Conclusion

The foregoing model improves previous models by allowing for multiple treatments per crop season logically interrelated to the pesticide dosage and to the costs and prices and by taking into account a setup cost associated with each application of the pesticide. The introduction of an explicit efficiency kill function for a specific insecticide provides the basis for solving the plant-insect control system to obtain an optimum strategy in terms of the dosages and number of treatments. True, the real world situation is much more complex, with insect migration, multiple insects and predators interfacing, and temperature and weather conditions affecting the actual immediate and final damage values. Nevertheless, the relative interaction between the X's and n would hopefully give some indication of their behavior in the realistic situation. The model can be used in the design of new price policies (taxes or subsidies) by measuring their effects on the behavior of the pesticide and plant industries. Lack of biological knowledge about the explicit behavior of the insects-plant ecosystems will probably prohibit accurate analysis for some time to come. Construction of models such as the one described here may point out areas of needed biological research.

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Effects of Tax Depreciation Policy and Investment Incentives on Optimal Equipment Replacement Decisions*

Anthony H. Chisholm

A model is developed to analyze the effects of income tax policy on the optimal timing of replacement for farm machinery. The impact of some forms of tax investment incentives on optimal replacement age was found to be substantial while the influence of different tax depreciation methods is minimal.

Key words: **income tax policies; optimal replacement; farm machinery.**

Tax policy has been widely used by governments as a means of influencing firms' investment decisions. The focus of this paper is on one particular aspect of taxation and investment decisions, namely the influence of tax policy on optimal replacement decisions for farm machinery.

In an important contribution to the theory of capital replacement, Preinreich [14] argues that the optimal service life of a machine cannot be determined in isolation from the economic life of each machine in the chain of future replacements extending as far into the future as the firm's planning horizon. Preinreich proposes that the firm should maximize the net present value of all future replacements, where the net present value is defined as the present value of aggregate earnings from all future machine replacements less the present value of the aggregate costs of all future machine replacements.

While it was perhaps natural to develop the theory of capital replacement in terms of profit maximization, this objective commonly poses severe problems of measurement owing to the difficulty of identifying the returns attributable to the use of a particular machine. The conventional method of overcoming this problem is to reformulate the profit maximization problem as one of cost minimization. Smith [16, Ch. 5] argues that in the absence of technological change in equipment, the replacement decision cannot affect either price or output. When a firm's price-output decisions are independent of its replacement decisions, cost minimization and profit maximization are completely separable.

The replacement model used in the present study assumes that firms aim to minimize the present cost of obtaining a *constant* flow of machine services over an infinite planning horizon. A stationary technology is assumed in which machines are replaced by machines of identical type, under conditions of certainty.

The paper is divided broadly into two main parts. In the first section a discrete-time replacement model incorporating income tax policy is developed, and the implications that the model holds for tax policy and optimal replacement decisions are discussed. In the following section the model is applied to a case study of the effects of recent changes in Australian income tax legislation on optimal replacement ages for farm tractors. Additionally, some comparisons are drawn between Australian and United States income tax legislation pertaining to investment in farm machinery.

A Discrete-Time Replacement Model With Tax

Replacement studies have variously used both continuous and discrete-time period models. The replacement model is represented here in terms of discrete-time variables, since this model is well adapted to real world problems involving short-lived assets of the type analyzed here. With a discrete-time model it is necessary to make some arbitrary definitions with respect to the point, within a discrete period, when costs (including tax payments) are incurred and replacement may occur. Both costs and replacement are defined here to occur at the end of each annual period.

Since the replacement problem, in the absence of taxation effects, is well covered in the economic literature, attention is now given to developing a

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model which incorporates taxation.[1] The following notation will be used:

$n =$ the replacement age measured in years;
$r =$ the firm's after-tax discount rate;
$M_o =$ the acquisition cost of a new machine;
$M_n =$ the resale value of a machine aged n years;
$R_k =$ the machine operating cost in year k;
$D_k =$ the amount of a depreciation allowance in year k;
$I =$ the amount of an investment allowance;
$T =$ the firm's rate of income tax;
$Q_n =$ the after-tax present value of the stream of costs for a single machine;

and

$V_n =$ the after-tax present value of the stream of costs for an infinite chain of identical machines, each replaced at age n years.[2]

The most significant features of an income tax, with respect to its influence on optimal replacement decisions, are the time pattern of the tax-deductibility of depreciation and the presence of any special investment incentives.[3] As a point of departure for developing a "with-tax" replacement model incorporating these features, an expression is required for the after-tax present value of the stream of costs for a single machine. The relationship is

$$(1)\quad \begin{aligned} Q_n = {} & (M_o - M_n[1+r]^{-n}) \\ & + 1 - T(\sum_{k=1}^{n} R_k[1+r]^{-k}) \\ & - T(I[1+r]^{-1}) \\ & - T(\sum_{k=1}^{n} D_k[1+r]^{-k}) \\ & + T([\sum_{k=1}^{n} D_k - M_o + M_n][1+r]^{-n}). \end{aligned}$$

The first term on the right-hand side of (1) specifies the present capital cost of a machine which is replaced at age n years. The second term defines the after-tax present value of cumulative operating costs. The following two terms define, respectively, the present value of the tax savings from an investment allowance and the depreciation allowance. The final term is a balancing charge adjustment. Conventionally, a balancing charge adjustment is made when a divergence occurs between resale value and depreciated book value at the time of asset disposal. If the resale value exceeds the depreciated book value, the "excess depreciation" is added to taxable income.[4] Conversely, if the resale value is less than the depreciated book value, the loss may be deducted from that year's taxable income.

Assuming now an infinite planning horizon, the after-tax present value of the stream of costs for a perpetual chain of machines, each replaced at age n, may be defined as:

$$(2)\qquad V_n = Q_n + V_n(1+r)^{-n}.$$

Solving relation (2) for V_n gives

$$(3)\qquad V_n = \frac{Q_n}{1-(1+r)^{-n}}.$$

The optimal replacement interval could be determined by calculating the values of V_n for the complete set of feasible replacement ages and selecting the minimum value. However, to analyze the effects of tax policy on optimal replacement decisions, it is necessary to derive a more complete replacement criterion which incorporates the marginal conditions required for an optimum.

A replacement model with marginal criteria

Marginal conditions for optimal replacement can be derived from the following two inequalities:

$$(4)\qquad V_n \leqslant V_{n+1},$$

$$(5)\qquad V_n \leqslant V_{n-1}$$

which must hold for n an optimum.[5]

Substituting (3) in the right-hand side of (4), one obtains

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[1] Papers published in this *Journal* on the economics of replacement include Burt [2], Chisholm [4], Faris [8], Perrin [13], and Winder and Trant [19]. For further studies which provide useful insights into the replacement problem, see Burt [1], Dean [6], Dillon [7, Chap. 3], Hirshleifer [11, Chap. 3], Lutz and Lutz [12, pp. 101–114], and Terborgh [18].

[2] Both a firm's after-tax discount rate and its rate of income tax are assumed to be constant over time.

[3] Equation (1) includes a term for an investment allowance that permits a specified proportion of the cost of a new machine to be deducted from taxable income in the year of its acquisition. This investment incentive is separate from, and additional to, the depreciation allowance. It differs from the United States investment credit which provides a direct credit against the payment of taxes and which is independent of a firm's rate of income tax.

[4] The option of having a balancing charge adjustment deducted from the tax depreciation base of the replacement asset, thus reducing future depreciation deductions, is not considered in the present study.

[5] The general procedure for deriving marginal conditions for optimal replacement in the form of two inequalities was developed by Burt [2].

$$V_n \leqslant \frac{Q_{n+1}}{1-(1+r)^{-(n+1)}}$$

or the following equivalent inequality,

$$V_n \leqslant Q_{n+1} + V_n(1+r)^{-(n+1)}.$$

Finally, substituting (2) into the above inequality and rearranging terms gives

$$(6)\quad Q_{n+1} - Q_n \geqslant V_n(1+r)^{-n} - V_n(1+r)^{-(n+1)}.$$

Substituting (1) in the left-hand side of (6) gives

$$\begin{aligned}(7)\quad & [M_o - M_{n+1}(1+r)^{-(n+1)} \\ & + 1 - T(\sum_{k=1}^{n} R_k[1+r]^{-k}) \\ & + 1 - T(R_{n+1}[1+r]^{-[n+1]}) \\ & - T(I[1+r]^{-1}) - T(\sum_{k=1}^{n} D_k[1+r]^{-k}) \\ & - T(D_{n+1}[1+r]^{-[n+1]}) \\ & + T([B_{n+1}][1+r]^{-[n+1]})] \\ & - [M_o - M_n(1+r)^{-n} \\ & + 1 - T(\sum_{k=1}^{n} R_k[1+r]^{-k}) - T(I[1+r]^{-1}) \\ & - T(\sum_{k=1}^{n} D_k[1+r]^{-k}) + T([B_n][1+r]^{-n})] \\ & \geqslant V_n(1+r)^{-n} - V_n(1+r)^{-(n+1)}\end{aligned}$$

where $B_n = (\sum_{k=1}^{n} D_k - M_o + M_n)$, which is the undiscounted balancing charge adjustment.

Canceling like terms of opposite sign and dividing both sides of the inequality of (7) by $(1+r)^{-(n+1)}$ gives

$$\begin{aligned}(8)\quad & M_n(1+r) - M_{n+1} + 1 - T(R_{n+1}) \\ & - T(D_{n+1}) + T(B_{n+1}) - T(B_n[1+r]) \\ & \geqslant V_n(1+r) - V_n.\end{aligned}$$

Rearranging terms on both sides of the inequality of (8) yields

$$\begin{aligned}(9)\quad & 1 - T(R_{n+1}) + (M_n - M_{n+1}) \\ & + rM_n - T(D_{n+1}) \\ & + T(B_{n+1} - B_n[1+r]) \geqslant rV_n.\end{aligned}$$

Applying similar algebraic operations to (5), one can derive:

$$\begin{aligned}(10)\quad & 1 - T(R_n) + (M_{n-1} - M_n) \\ & + rM_{n-1} - T(D_n) \\ & + T(B_n - B_{n-1}[1+r]) \leqslant rV_n.\end{aligned}$$

The optimal policy for replacement is therefore defined by the double inequality

$$\begin{aligned}(11)\quad & 1 - T(R_{n+1}) + (M_n - M_{n+1}) + rM_n \\ & - T(D_{n+1}) + T(B_{n+1} - B_n[1+r]) \\ & \geqslant rV_n \geqslant 1 - T(R_n) \\ & + (M_{n-1} - M_n) + rM_{n-1} \\ & - T(D_n) + T(B_n - B_{n-1}[1+r]).\end{aligned}$$

The optimal policy is to continue to hold the current machine until the marginal cost of holding the machine for a further year exceeds the amortized cost, rV_n, which in turn exceeds the marginal cost incurred in the preceding year.[6] At this point, the marginal cost with respect to time (machine age) most closely approximates the average cost per unit of time, i.e., the amortized cost.

In empirical applications, probably the best method of determining the optimal replacement age is to evaluate the middle expression of (11), for $n = 1, 2, 3, \cdots$; and select the integer value of n for which the amortized cost is a minimum. Substituting from (1) and (3) into the middle expression of (11), the complete relationship for the amortized cost is

$$\begin{aligned}(12)\quad rV_n = & \frac{r}{1-(1+r)^{-n}} \\ & [(M_o - M_n[1+r]^{-n}) \\ & + 1 - T(\sum_{k=1}^{n} R_k[1+r]^{-k}) - T(I[1+r]^{-1}) \\ & - T(\sum_{k=1}^{n} D_k[1+r]^{-k}) \\ & + T([\sum_{k=1}^{n} D_k - M_o + M_n][1+r]^{-n})].\end{aligned}$$

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[6] The main differences between (11) and the corresponding before-tax replacement criterion are additional terms for depreciation and the balancing charge adjustment on both the right-and left-hand sides of (11) and the incorporation of these effects plus the influence of the investment allowance in the middle expression. A sufficient condition for there to be only one value of n which satisfies (11) is that starting from $n = 1$, V_n is monotone decreasing to some point $n = k$ and thereafter monotone increasing. This condition will not always be met, and in empirical work it will usually be necessary to evaluate V_n for the complete set of feasible replacement ages.

It follows from relations (11) and (12) that the influence of the separate components of tax policy on optimal replacement decisions can be assessed by determining the functional relationship between the annuity value of an investment allowance (and a depreciation allowance) and replacement age.

Consider first an investment allowance of amount I, which is written off against taxable income at the end of the first year of a machine's life. From equation (12) the after-tax annuity value of an investment allowance (denoted I^*), is

$$(13)\quad I^* = \frac{r}{1-(1+r)^{-n}} \cdot (I[1+r]^{-1})\,T.$$

The value of the annuity factor in relation (13) is inversely related to the value of n, and it is thus clear that the value of I^* will also vary inversely with n.[7] It follows that if the annuity value of the tax saving from an investment allowance is a decreasing function of replacement age, an investment allowance will induce a bias towards *shorter* optimal replacement intervals.

Determination of the effect of the time pattern of tax-deductible depreciation on optimal replacement age is a more difficult task, because it is necessary first to define a "neutral" depreciation allowance which can be used as a basis for comparison. For this purpose the author drew upon a fundamental theorem of tax-rate invariance established by Samuelson [15, p. 604]:

> If, and only if, true loss of economic value is permitted as a tax-deductible depreciation expense will the present discounted value of a cash-receipt stream be independent of the rate of tax.

Based upon this theorem, a depreciation schedule (henceforth termed a *neutral* depreciation allowance) which allows the actual annual decline in asset value to be deducted from taxable income in the year it is incurred is used as a basis for comparison.[8]

In the latter part of the application of the model which follows, the effect of alternative depreciation allowances on the replacement decision is assessed by evaluating the absolute difference between the annuity value of a neutral depreciation allowance and the annuity value of the particular depreciation schedule under consideration, for $n = 1, 2, 3, \cdots$.[9]

An Application

In 1973 two important changes were made to the income tax legislation pertaining to investment in farm machinery in Australia.[10] First, an investment allowance of 20 percent of machine cost, deductible from taxable income in the year of purchase of a new machine, was removed. Second, an accelerated depreciation schedule, which allowed the cost of farm machinery to be written off over five years at the rate of 20 percent per annum, was replaced with a "standard" depreciation schedule allowing a 15 percent per annum write-off over the first six years and a 10 percent write-off in the seventh year.

To illustrate the effects of these changes in income tax policy on optimal replacement decisions, the replacement model is applied to survey cost data for a farm tractor. The estimated annual operating costs and resale values for a farm tractor with an acquisition cost of $3,100 are given in Table 1.[11] Applying the replacement model derived earlier to this data, the optimal replacement ages are evaluated for various com-

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[7] It can be seen both from inspection and from tabled values of the annuity factor, $\frac{r}{1-(1+r)^{-n}}$, that its value (and therefore I^*) is monotone decreasing for $n = 1, 2, 3, \cdots$.

[8] Some economists, for instance Smith [17], have proposed that neutral tax depreciation write-off rules would permit all capital outlays to be fully expensed—that is, a policy of 100 percent immediate depreciation regardless of the economic life of an asset. The conflict between Samuelson's [15] and Smith's conclusions may be explained by the fact that Smith's analysis *implicitly* assumes that a firm's before- and after-tax discount rate are identical. Samuelson, on the other hand, explicitly assumes that under a neutral income tax the after-tax discount rate will always equal $(1-T)$ times the before-tax discount rate. I consider Samuelson's interpretation to be the correct one.

[9] From equation (12) I define the annuity value of a depreciation allowance—net of the balancing charge adjustment—as

$$\frac{r}{1-(1+r)^{-n}}\left([\sum_{k=1}^{n} D_k(1+r)^{-k}] - [\sum_{k=1}^{n} D_k - M_o + M_n]\right).$$

Multiplying this expression by T, I obtain the net value of the annuity to a particular firm.

[10] These tax changes were first announced by the Australian Federal Treasurer in the 1973–74 Budget Speech.

[11] Table 1 is based on farm survey data of tractor costs obtained from a study made by Harrison [10]. Both Harrison's study and a separate study by Glau [9] examine the problem of the optimal timing of replacement of farm equipment under an income tax. In neither study, however, was a satisfactory methodology given for rigorously analyzing the effects of different tax policies on optimal replacement.

Table 1. Operating costs and resale values for a farm tractor

Replace at End of Year	Tax Deductible Operating Costs	Resale Price	Actual Depreciation	Cumulative Capital Cost
1	472	2508	592	592
2	557	2235	273	865
3	529	1992	243	1108
4	636	1775	217	1325
5	674	1582	193	1518
6	826	1410	172	1690
7	546	1257	153	1843
8	612	1120	137	1980
9	808	998	122	2102
10	798	889	109	2211
11	805	793	96	2307

Table 2. Optimum replacement intervals (years)*

Discount Rate (percent)	Marginal Income Tax Rate (percent)			
	0	12.5	25	50
0	8 (8)	8 (8)	3 (8)	1 (8)
5	11 (11)	8 (11)	8 (11)	1 (11)
7.5	11 (11)	11 (11)	11 (11)	1 (11)
10	11 (11)	11 (11)	11 (11)	1 (11)

* The figures without and within parentheses in the body of the table show the optimal replacement intervals *before* and *after* the tax change, respectively.

binations of rates of discount and rates of income tax. The optimal replacement intervals for both the before and after tax change situations are given in Table 2.

The results show that before the tax change, the optimal replacement interval was sensitive to both a firm's rate of discount and its rate of income tax. Higher rates of discount are associated with longer optimal replacement intervals, while higher rates of income tax are associated with shorter optimal replacement intervals. After the tax change the optimal replacement age remains sensitive to a firm's rate of discount, but is no longer influenced by the rate of income tax. After the tax change the optimal replacement ages are in fact identical to those which would obtain with a neutral depreciation schedule. A comparison of the before and after tax change results enables us to assess the impact of the tax reform on optimal replacement decisions.[12] The most striking observation is that the combined removal of the investment allowance and the accelerated depreciation allowance has substantially increased the optimal replacement age of tractors for farmers in high tax brackets. For a 50 percent rate of income tax, for instance, the optimal replacement age increases from one to 11 years.

Further insight into the influence of the tax change on optimal replacement strategies can be gained by separating the effect of the removal of the investment allowance from the effect of the removal of the accelerated depreciation allowance. This separation is achieved by calculating optimal replacement ages for a tax policy which allows accelerated depreciation, but which has no investment allowance. The optimal replacement ages for this situation are identical to those given in parentheses in Table 2. Thus the changes in optimal replacement ages shown in Table 2 derive solely from the removal of the investment allowance.

To draw some comparisons between the Australian and United States income tax legislation and to allow further testing of the sensitivity of optimal equipment replacement decisions to tax policy, the replacement model was also used to examine the current United States tax situation. The main features of the current United States income tax legislation, as it relates to investment in farm machinery, are an investment credit; a choice between several forms of depreciation write-off including some accelerated forms of depreciation; and an additional first-year depreciation allowance. In addition, and in contrast to the former tax situation in Australia, there are strict rules governing the minimum number of years (useful life) that an asset must be held by a firm to qualify for the above forms of favorable tax treatment.[13]

Using the data in Table 1, and assuming a 50 percent rate of income tax, optimal replacement ages were determined under the United States straight line and the sum of the years-digits methods of depreciation respectively, both with and without the investment credit and the additional first-year depreciation allowance. For all of the above combinations, the optimal replacement ages were identical with those given in brackets in the right-hand side column of Table 2, i.e., under the current "standard" Australian depreciation allowance. In effect, the strict eligibility rules which allow assets to qualify for favorable tax treatment only if they are held by a firm for certain minimum time periods nullify any incentives that may otherwise be given towards more rapid replacement.

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[12] The above analysis is in the nature of partial equilibrium theory, since the structure of secondhand tractor prices is assumed to remain constant. An extension of the analysis would be to construct a model of the market for new and secondhand tractors and examine simultaneously the effects of changes of tax policy on the structure of equilibrium tractor prices and optimal replacement. For a study on the secondhand market for farm machinery, see Candler [3].

[13] A detailed description of U. S. tax policy relating to investment in farm equipment is contained in [20]. In my analysis, I assume that U. S. farmers accurately predict the future resale (salvage) value of their equipment when calculating tax-deductible depreciation, so that there is no balancing charge (recapture) at the time of its disposal.

Finally, as was discussed earlier in the paper, a more precise measure of the influence on replacement of the time pattern of tax-deductibility of depreciation can be obtained by evaluating absolute differences between the annuity value of a neutral depreciation allowance and the annuity value of the particular depreciation schedule under consideration, for each feasible replacement age. Using the data in Table 1, the above calculations have been made for a number of alternative forms of depreciation. The results are presented in Table 3.

The procedure for assessing the direction of the effect of a particular method of depreciation on replacement age may be illustrated by considering the most extreme form of accelerated depreciation, namely an immediate 100 percent depreciation allowance. From Table 3 it can be seen that the annuity value of this depreciation allowance exceeds that of a neutral depreciation allowance for all values of n. The absolute difference between the annuity values of the two depreciation schedules is, however, a decreasing function of n. Hence, an immediate 100 percent write-off policy induces a bias towards shorter replacement intervals. This situation does not apply, however, with all forms of accelerated depreciation, as can be seen from the results for the former Australian accelerated depreciation allowance, where the bias is in the opposite direction.

It is apparent from the results given in Table 3 that there is no simple general rule for predicting the direction of bias on replacement age of a particular method of depreciation. Perhaps more important is the fact that in no instance was the magnitude of the bias stemming from a particular method of depreciation of sufficient size to change the optimal replacement age.[14]

Conclusions

A replacement model has been developed to analyze the effects of the time pattern of the tax depreciation policy and special investment incentives, on optimal farm equipment replacement decisions. A case study application of the model to analyze the effects of recent changes in Australian income tax legislation showed that the combined removal of a 20 percent investment allowance and an accelerated depreciation allowance substantially increases the optimal tractor replacement age for high tax bracket farms. Separation of the influence of the investment allowance from that of the accelerated depreciation allowance indicated that the impact of the tax change on optimal replacement age was solely attributable to the removal of the investment allowance.

The main indications emerging from a rather more restricted application of the model to United States tax policy were that due largely to the rules preventing assets receiving favorable tax treatment from being turned over too rapidly, the current tax policy would not appear to influence significantly the optimal farm machinery replacement decisions.

Evaluation of the relationship between the annuity value and replacement age for each of a number of alternative feasible depreciation methods—with the same annuity relationship for a neutral depreciation allowance—indicated that changes in the time pattern of the tax-deductibility of depreciation will in general have only minimal influence on optimal replacement decisions.

Finally, it may be observed that the original policy goal of the Australian investment allowance was to stimulate the use of new and up-to-date equipment in primary production [5, p. 23]. While this policy goal was probably to some extent achieved, it is not desirable from either an equity or efficiency viewpoint to provide an incentive the size of which is directly linked to a firm's marginal tax bracket. In this respect an investment credit which is independent of a firm's marginal tax bracket would appear to be a superior form of investment incentive.

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[14] It is apparent, though, from some of the large differences between the annuity values given in Table 3 that regardless of the timing of replacement, the impact of *different* methods of depreciation on the after-tax annuity cost of machine services can vary substantially.

Table 3. Annuity values for various depreciation methods relative to a neutral depreciation allowance

Replace at End of Year	Former Australian Accelerated Depreciation Plus Investment Allowance	Former Australian Accelerated Depreciation Only	Current Australian Standard Depreciation	U. S. Straight Line Depreciation	U. S.[a] Sum of the Years-Digits Method Plus Additional First-Year Depreciation	U. S.[b] Investment Credit	Immediate 100 Percent Depreciation	Total Depreciation at Time of Asset Disposal
1	620	0	0	0	—	—	310	0
2	288	1	—6	—7	—	—	282	—26
3	204	12	—3	—12	—	26	264	—46
4	170	26	5	—14	—	21	251	—59
5	156	40	12	—17	—	35	238	—72
6	153	56	21	—19	20	30	228	—82
7	148	64	30	—23	21	40	218	—92
8	144	70	38	—25	21	37	210	—100
9	139	73	44	—28	21	34	203	—107
10	135	75	48	—31	21	32	197	—113
11	129	75	50	—34	20	30	191	—119

[a] An asset must be held by a firm for at least three years to qualify for the sum of the years-digits method of depreciation and a period of at least six years to qualify for a 20 percent additional first-year depreciation allowance. For $n \geqslant 3$ the differences between the sum of the years-digits method only and neutral depreciation was negligible.

[b] An asset must be held for at least three years for a firm to receive any investment credit and at least seven years to receive the full investment credit.

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Institutional Affiliation of Authors of Contributions to the *American Journal of Agricultural Economics*—1953–1972*

DAVID W. HOLLAND AND JOHN C. REDMAN

Contributions to the *American Journal of Agricultural Economics* were tabulated for the periods 1953–1962, 1963–1967, and 1968–1972. Institutional juxtaposition through time for both invited and noninvited articles was observed. Rankings by subject category were provided for the most recent five-year period.

***Key words:* *AJAE*; articles; ranking; subject matter.**

NEARLY TWO DECADES AGO Arnold and Barlowe [1] examined contributions to the *Journal of Farm Economics* for the first 35 years—1919–1953. They classified contributions according to subject matter, institutional affiliation, author, and article type. Schools and authors were ranked according to number of contributions. Article distribution by subject class and source was also examined (see also [4]). In 1963 the issue of frequency of invited papers was raised by Moore [5] and Bird [2]. Data were presented that indicated the concentration of invited papers among land-grant institutions. Later in 1963 Nielson and Riley [6] examined the concentration of authorship of papers in the four regular issues of the *Journal* from 1958 through 1963. Recently Redman [7] examined the geographic distribution of AAEA membership and journal authorship, and Finley [3] reviewed the extent to which the *Journal* was used as a reference source. While there has been a substantial number of papers dealing with either the Association or the *Journal,* there has not been, in the past two decades, a thorough examination of the contents of the *Journal* of the type conducted by Arnold and Barlowe. The purpose of this paper is to provide such an examination.

This paper will (1) provide tabulations, by institutional affiliation of authors, for all papers appearing in the *American Journal of Agricultural Economics* for the periods 1953–1962, 1963–67, and 1968–72; (2) provide separate tabulations of the same information for invited as distinguished from noninvited papers; (3) examine the concentration of authorship in the *AJAE* by major source; (4) examine the distribution of papers by subject category; and (5) tabulate the top five universities in each subject category.[1]

Institutional Affiliation of Authors Appearing in the *AJAE,* 1953–62, 1963–67, and 1968–72

The 30 institutions contributing the greatest number of pages to the *Journal* are shown in Table 1. Contributions in Table 1 include both invited and noninvited papers. All regular articles, short articles, notes, communications, viewpoints, or contributed papers were classified as noninvited. Discussions and invited papers were counted as invited. Book reviews, announcements, news notes, or biographical sketches were not counted. Multiple authorships associated with different institutions were allocated a proportionate number of pages.

The USDA had the greatest contribution of pages in all three time periods. However, the percentage contribution of the USDA consistently declined—from 16.42 percent in the first period to 10.66 percent in the most recent period. The opposite trend characterized contributions from foreign sources. Foreign authorship increased from 5.38 percent in 1953–1962 to 9.40 percent in 1968–1972.

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[1] The results of a similar study for general economics are summarized in the paper by Seigfried [8]. In addition to tabulations on publishing performance, Seigfried examined the relationship between publication and graduate faculty ranking. Quality rankings were available for 36 universities. When quality ranking was regressed on a set of predetermined variables, the variables exhibiting a significant relationship were the number of Ph.D.'s awarded by the institution's economics department and number of pages contributed to the *American Economic Review* and *Econometrica.* Faculty size was not significant, but sufficient variation may not have been present to allow a significant effect to be detected. In agricultural economics, "public service" and station publications are given greater weight than in general economics. Other journals such as *Land Economics* are also regularly used by members. Nevertheless, *AJAE* contributions are easily quantified and, in the opinion of the authors, represent one of several important indicators of departmental quality.

University publishing performance was quite variable. Schools originally in the top 30 which experienced at least a five-unit increase in ranking between 1953–1962 and 1968–1972 were Oregon State, Purdue, Illinois, Missouri, Ohio State, and California-Davis. Schools which experienced at least a five-unit decrease in ranking but remained in the top 30 were North Carolina State, California-Berkeley, Chicago, Washington State, and Michigan State.

Universities leaving the top 30 between the first and third periods were Stanford, Harvard, Vanderbilt, Kentucky, Connecticut, and Nebraska. Schools joining the top 30 were Texas A & M, Arizona, Florida, and Kansas State.[2] Smaller non-land grant schools whose contributions were categorized as Midwestern and Western entered the top 30 in the most recent period indicating a more widespread contribution from non-land grant schools in the 1968–1972 period.

Noninvited papers

Invited papers are distinguished from noninvited papers in Tables 2 and 3 respectively. The USDA was the top contributor to the noninvited category during the first two periods. In the most recent period, however, first place was held by foreign authors, and by a rather large amount. Purdue has become the top-ranked university, moving from fourth place among the universities in 1953–1962. Schools showing large or consistent improvement in *Journal* contribution were Wisconsin, California-Davis, Purdue, Missouri, Illinois, Cornell, Oregon State, Oklahoma State, Texas A & M, and Ohio State. Schools showing substantial decrease in noninvited contributions were Chicago, California-Berkeley, Stanford, and, in the most recent five-year period, Minnesota. Other schools showing lesser declines recently were Iowa State, Michigan State, Kansas State, and Arizona.

Some schools tend to be quite variable in *AJAE* contributions while others are very steady. No explanation is offered here, but it is simply noted as an observable phenomenon. For example, Pennsylvania State started in 16th, dropped to 25th, and moved up to 10th. Minnesota started in 10th, moved to 6th, and dropped to 25th. Arizona moved from 37th to 13th but dropped to 24th. On the other hand, Iowa State

Table 1. Institutional affiliation of authors contributing papers to *AJAE*—1953–1972

	1953-62			1963-67			1968-72		
Institution	Rank	Pages	% of Total	Rank	Pages	% of Total	Rank	Pages	% of Total
U. S. Department of Agriculture	1	2,251.00	16.43	1	1,084.83	15.45	1	563.00	10.65
Iowa State University	2	905.00	6.60	5	286.25	4.08	5	202.50	3.83
Michigan State University	3	842.00	6.14	4	287.25	4.09	8	180.00	3.41
Other Government Agencies	4	745.50	5.44	10	216.50	3.08	7	181.41	3.43
Foreign Sources	5	737.00	5.38	2	607.00	8.65	2	496.50	9.39
Business Firms & Trade Associations	6	661.00	4.82	11	216.25	3.08	9	170.25	3.22
University of California - Berkeley	7	605.00	4.41	22	97.25	1.39	14	143.50	2.72
Purdue University	8	519.00	3.79	6	281.15	4.00	3	237.00	4.48
North Carolina State University	9	496.00	3.62	14	187.50	2.67	16	139.75	2.64
University of Wisconsin	10	484.50	3.54	7	265.75	3.79	6	198.25	3.75
University of Chicago	11	423.50	3.09	20	108.75	1.55	20	90.75	1.72
University of Minnesota	12	385.50	2.81	3	313.25	4.46	12	153.50	2.90
Cornell University	13	310.00	2.26	12	195.00	2.78	17	137.25	2.60
Pennsylvania State University	14	282.00	2.06	19	113.00	1.61	15	143.25	2.71
University of Illinois	15	253.50	1.85	8	253.25	3.61	4	230.50	4.36
University of California - Davis	16	245.00	1.79	9	247.50	3.53	11	156.00	2.95
Foundations	17	225.50	1.65	13	189.50	2.70	19	100.50	1.90
University of Missouri	18	221.50	1.62	15	139.83	1.99	10	165.50	3.13
Stanford University	19	210.00	1.53	28	66.50	0.95		xxxxxx	
Oklahoma State University	20	205.00	1.50	17	133.58	1.90	18	106.00	2.01
Washington State University	21	160.00	1.17	26	73.00	1.04	27	65.50	1.24
University of Kentucky	22	158.00	1.15		xxxxxx			xxxxxx	
Harvard University	23	153.50	1.12	27	71.00	1.01		xxxxxx	
University of Connecticut	24	151.00	1.10	25	74.25	1.06		xxxxxx	
Other Eastern Colleges & Universities	25	139.00	1.01	18	118.25	1.68	21	84.50	1.60
Vanderbilt University	26	137.50	1.00		xxxxxx			xxxxxx	
University of Nebraska	27	128.50	0.94		xxxxxx			xxxxxx	
Unaffiliated or Other Affiliation	28	115.50	0.84		xxxxxx			xxxxxx	
Oregon State University	29	103.00	0.75	21	97.75	1.39	13	146.00	2.76
Ohio State University	30	102.00	0.74	29	53.25	0.76	25	71.75	1.36
University of Arizona		xxxxxx		16	139.25	1.98	23	73.75	1.40
Other Southern Colleges & Universities		xxxxxx		23	79.75	1.14	28	63.00	1.19
Kansas State University		xxxxxx		24	76.50	1.09	29	62.75	1.19
South Dakota State University		xxxxxx		30	52.00	0.74		xxxxxx	
Other Midwestern Colleges & Universities		xxxxxx			xxxxxx		22	83.95	1.59
Texas A & M University		xxxxxx			xxxxxx		24	73.25	1.39
University of Florida		xxxxxx			xxxxxx		26	69.07	1.31
Other Mountain & Western Colleges & Univ.		xxxxxx			xxxxxx		30	60.50	1.14
All Others		1,349.00	9.85		895.95	12.76		635.95	12.03
TOTAL		13,704.50	100.00		7,020.84	100.00		5,285.38	100.00

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[2] School rankings associated with earlier time periods are reviewed in Arnold and Barlowe [1, p. 450].

Table 2. Institutional affiliation of authors contributing invited papers to *AJAE*—1953–1972

	Invited Papers								
	1953-62			1963-67			1968-72		
Institution	Rank	Pages	% of Total	Rank	Pages	% of Total	Rank	Pages	% of Total
U. S. Department of Agriculture	1	1,390.50	18.81	1	499.00	17.90	1	272.25	12.45
Business Firms & Trade Associations	2	478.00	6.47	3	144.50	5.18	4	112.00	5.12
Other Government Agencies	3	458.50	6.40	6	108.75	3.90	2	133.75	6.11
Michigan State University	4	456.00	6.17	5	123.00	4.41	5	96.25	4.40
Iowa State University	5	391.50	5.30	11	82.50	2.96	7	86.50	3.95
University of Wisconsin	6	320.50	4.47	7	107.00	3.84	12	61.75	2.82
University of California - Berkeley	7	303.50	4.11	17	52.00	1.87	8	83.00	3.79
Foreign Sources	8	277.50	3.75	2	209.25	7.50	23	32.50	1.48
Purdue University	9	267.50	3.62	10	92.00	3.30	11	74.25	3.39
North Carolina State University	10	262.00	3.54	13	70.75	2.54	16	51.00	2.33
University of Chicago	11	233.00	3.15	12	82.00	2.94	15	51.25	2.34
University of Minnesota	12	196.00	2.65	4	128.50	4.61	3	114.75	5.25
University of Illinois	13	173.50	2.35	15	57.50	2.06	6	94.50	4.32
Cornell University	14	162.00	2.19	20	45.00	1.61	19	39.00	1.78
Pennsylvania State University	15	135.50	1.83	14	69.00	2.47	14	51.75	2.37
Foundations	16	124.50	1.68	9	100.50	3.60	9	81.25	3.71
Stanford University	17	117.50	1.59		xxxxxx			xxxxxx	
Harvard University	18	102.00	1.38	22	35.00	1.26	22	34.00	1.55
Unaffiliated or Other Institutions	19	96.00	1.30		xxxxxx			xxxxxx	
University of Connecticut	20	86.00	1.16	19	45.50	1.63		xxxxxx	
University of Nebraska	21	82.50	1.12		xxxxxx			xxxxxx	
Vanderbilt University	22	77.00	1.04	27	24.25	0.87	29	25.00	1.14
Oklahoma State University	23	75.00	1.01	18	51.50	1.85	28	25.50	1.17
University of California - Davis	24	73.00	0.99	8	104.00	3.73	24	29.00	1.32
University of Missouri	25	72.50	0.98	24	26.00	.93	13	58.50	2.67
University of Kentucky	26	70.50	0.95		xxxxxx			xxxxxx	
Other Eastern Colleges & Universities	27	61.00	0.83	21	41.75	1.50		xxxxxx	
Washington State University	28	56.00	0.76	25	25.00	0.90	27	26.00	1.19
University of Tennessee	29	52.00	0.70		xxxxxx			xxxxxx	
Ohio State University	30	51.00	0.69		xxxxxx		30	24.50	1.11
Oregon State University		xxxxxx		16	52.50	1.89	10	77.75	3.55
University of Arizona		xxxxxx		23	28.50	1.02	20	34.50	1.58
Other Southern Colleges & Universities		xxxxxx		26	24.50	0.88	18	40.50	1.85
Texas A & M University		xxxxxx		28	22.50	0.81	26	26.75	1.22
University of Florida		xxxxxx		29	21.50	0.77	17	46.00	2.10
University of Georgia		xxxxxx		30	19.00	0.68		xxxxxx	
Kansas State University		xxxxxx			xxxxxx		21	34.00	1.55
Other Mountain & Western Colleges & Univ.		xxxxxx			xxxxxx		25	28.50	1.30
South Dakota State University		xxxxxx			xxxxxx			xxxxxx	
Virginia Polytechnic Inst. & State Univ.		xxxxxx			xxxxxx			xxxxxx	
All Others		691.00	9.35		295.45	10.60		240.85	11.01
TOTAL		7,393.00	100.00		2,788.20	100.00		2,187.10	100.00

ranked in the top 10 in each time period and was the only school to achieve that distinction. Other schools showing very consistent performance in the last 10 years were Purdue, Wisconsin, Illinois, Cornell, and North Carolina State.

Invited papers

Those institutions which have greater emphasis on policy-oriented questions have also accounted for a relatively large percentage of invited pages. The USDA, Other Government Agencies, Business Firms and Trade Associations, and Foundations have with one exception—Foundations in 1953–62—always ranked in the top 10 contributors of invited papers. Quite clearly there has been a consistent effort on the part of those organizing the annual meetings to broaden the base of business, foundation, and governmental participation.

University participation has not been as consistent as participation by non-school institutions. Only Michigan State ranked in the top 10 in all three periods. Schools appearing in the top 10 in two out of the three possible periods were Wisconsin, Purdue, California-Berkeley, Iowa State, and Minnesota.

When invited ranking was compared to noninvited ranking, certain institutions consistently ranked higher on invited pages than on noninvited pages and vice versa. As previously indicated, business, foundation, and government participation was considerably greater in the proceedings than in the noninvited portion of the *Journal*. Over the most recent 10 years schools consistently ranking higher in invited participation were California-Berkeley, Chicago, Harvard, Oregon State, and Florida. The opposite condition characterized Cornell, Purdue, and Missouri. In the most recent five years, California-Davis, Oklahoma State, and Foreign Sources ranked considerably lower in invited pages than in noninvited pages. The University of Minnesota provides the converse example ranking third in invited pages and 25th in noninvited pages.

Any number of factors may explain the difference in invited and noninvited participation. Inter-departmental and interregional politics must play an important role, but lack of infor-

Table 3. Institutional affiliation of authors contributing noninvited papers to *AJAE*—1953–1972

	Non-Invited Papers								
	1953-62			1963-67			1968-72		
Institution	Rank	Pages	% of Total	Rank	Pages	% of Total	Rank	Pages	% of Total
U. S. Department of Agriculture	1	860.50	13.63	1	585.83	13.94	2	290.75	9.39
Business Firms & Trade Associations	11	183.00	2.90	18	71.75	1.70	18	58.25	1.88
Other Government Agencies	6	287.00	4.55	14	107.75	2.55	19	47.66	1.54
Michigan State University	4	386.00	6.12	7	164.25	3.88	12	83.75	2.70
Iowa State University	2	513.50	8.14	3	203.75	4.81	7	116.00	3.75
University of Wisconsin	13	164.00	2.60	8	158.75	3.75	4	136.50	4.41
University of California - Berkeley	5	301.50	4.78	23	45.25	1.07	17	60.50	1.95
Foreign Sources	3	459.50	7.28	2	397.75	9.40	1	464.00	14.98
Purdue University	7	251.50	3.99	5	189.15	4.47	3	162.75	5.25
North Carolina State University	8	234.00	3.71	11	116.75	2.76	11	88.75	2.87
University of Chicago	9	190.50	3.02		xxxxxx		23	39.50	1.27
University of Minnesota	10	189.50	3.00	6	184.75	4.37	25	38.75	1.25
University of Illinois	22	80.00	1.27	4	195.75	4.62	5	136.00	4.39
Cornell University	15	148.00	2.35	9	150.00	3.54	9	98.25	3.17
Pennsylvania State University	16	146.50	2.32	25	44.00	1.04	10	91.50	2.95
Foundations	19	101.00	1.60	15	89.00	2.10		xxxxxx	
Stanford University	20	92.50	1.47	20	59.25	1.40		xxxxxx	
Harvard University	28	51.50	0.82	30	36.00	0.85		xxxxxx	
Unaffiliated or Other Institutions		xxxxxx			xxxxxx			xxxxxx	
University of Connecticut	25	65.00	1.02		xxxxxx		27	32.50	1.05
University of Nebraska		xxxxxx		27	38.00	0.90		xxxxxx	
Vanderbilt University	27	60.50	0.96		xxxxxx			xxxxxx	
Oklahoma State University	17	130.00	2.06	16	82.08	1.94	13	80.50	2.60
University of California - Davis	12	172.00	2.73	10	143.50	3.39	6	127.00	4.10
University of Missouri	14	149.00	2.36	12	113.83	2.69	8	107.00	3.45
University of Kentucky	21	87.50	1.39		xxxxxx		30	31.25	1.00
Other Eastern Colleges & Universities	23	78.00	1.26	17	76.50	1.81	14	71.50	2.31
Washington State University	18	104.00	1.65	22	48.00	1.13	22	39.50	1.25
University of Tennessee		xxxxxx			xxxxxx		26	34.55	1.12
Ohio State University	29	51.00	0.81	26	40.50	0.96	20	47.25	1.52
Oregon State University	24	77.00	1.22	24	45.25	1.07	15	68.25	2.20
University of Arizona		xxxxxx		13	110.75	2.62	24	39.25	1.27
Other Southern Colleges & Universities	26	61.50	0.97	21	55.25	1.31		xxxxxx	
Texas A & M University		xxxxxx			xxxxxx		21	46.50	1.50
University of Florida		xxxxxx			xxxxxx			xxxxxx	
University of Georgia		xxxxxx			xxxxxx			xxxxxx	
Kansas State University	30	47.50	0.75	19	69.50	1.64		xxxxxx	
Other Mountain & Western Colleges & Univ.		xxxxxx			xxxxxx		29	32.00	1.03
South Dakota State University		xxxxxx		28	38.00	0.90		xxxxxx	
Virginia Polytechnic Inst. & State Univ.		xxxxxx		29	36.00	0.85		xxxxxx	
Other Midwestern Colleges & Universities		xxxxxx			xxxxxx		16	66.75	2.16
University of Maryland		xxxxxx			xxxxxx		28	32.50	1.05
All Others		588.50	9.33		535.75	12.66		329.07	10.62
TOTAL		6,311.50	100.99		4,232.64	100.00		3,098.28	100.00

mation precludes further comment. The reason explaining relative lack of foreign participation in the meetings may simply be the existence of much greater travel costs. However, foreign authors were well-represented at meetings prior to the most recent five-year period. The relatively greater meetings contribution of schools such as California-Berkeley, Chicago, and Harvard may be due to greater emphasis on national rather than state policy issues. Another possible explanation is that certain schools may be populated by individuals who are recognized as always having something to say which is particularly interesting and enlightening. Also, meeting location and the university's travel policy may substantially affect a particular school's invited contribution.

Major Source of Authorship in the *AJAE*

Publication in the *AJAE* by major source is summarized in Table 4. The percent of pages con-

Table 4. The percentage distribution of pages contributed by general source—1953–1972

	1953-62			1963-67			1968-72		
General Source	All Papers	Invited Papers	Non-invited Papers	All Papers	Invited Papers	Non-invited Papers	All Papers	Invited Papers	Non-invited Papers
Land Grant Universities	55.04	52.01	58.58	56.65	50.91	61.75	60.67	59.55	61.81
Other Colleges & Universities	10.41	9.78	11.15	10.23	10.93	8.43	10.65	11.47	9.72
U. S. Department of Agriculture	16.43	18.81	13.64	15.45	17.90	13.94	10.66	12.44	9.39
Other Governmental Agencies	5.44	6.20	4.55	3.08	3.90	2.55	3.43	6.11	1.54
Foreign Sources	5.38	3.75	7.28	8.65	7.51	9.40	9.40	1.49	14.98
Business Firms & Trade Associations	4.83	6.47	2.89	3.08	5.18	1.70	3.22	5.12	1.88
Foundations	1.65	1.68	1.60	2.70	3.61	2.10	1.90	3.71	0.62
Unaffiliated or Other Affiliation	0.84	1.30	0.31	0.17	0.07	0.24	0.08	0.09	0.06
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

tributed by land grant institutions increased steadily between 1953–1962 and 1968–1972. The largest percentage increase for land grant schools came in the invited section—an increase of 7.54. The percent of pages allocated to Other Colleges and Universities did not change to any great degree, but participation of some schools such as Harvard, Chicago, Stanford, and Vanderbilt declined considerably in this category.

The USDA declined in participation in each category in every successive time period with one exception—noninvited papers in 1963–1968. The contributions of Other Government Agencies also decreased. Their noninvited contribution dropped from 4.55 percent to 1.54 percent. Participation in the meetings, however, shows some increase in recent years. Business Firms and Trade Associations maintained a relatively constant share as did Foundations, although foundations do show some increase in invited participation through time. The Unaffiliated or Other Affiliation category contained very few entries in recent periods. This reflects the fact that recently fewer authors fell into the Unaffiliated category. Second, the institutional affiliation of almost all recent authors was compatible with one of the other major categories, thus eliminating the need for the "Other Affiliation" category. The implication is that representations of unions, school boards, hospital boards, consumer protection groups, and environmental protection groups has been very small in recent meetings—perhaps even smaller than in earlier years.

Concentration of pages in the top-ranked universities is summarized in Table 5. The percentage of noninvited pages contributed by schools in the top 30 declined slightly between 1953–1962 and 1968–1972. Over the same time period, concentration of invited pages increased. The tendency exhibited in the 1963–1967 period of having fewer invited pages concentrated in the larger schools was strongly reversed in the 1968–1972 period.

Table 5. Contributions by the top 30 institutions

Article Type	1953–1962	1963–1967	1968–1972
		(Percent of all contributions)	
Invited	52.58	48.94	56.89
Non-Invited	58.55	54.64	56.12

Contributions According to Subject Category

All contributions to the *Journal* were classified according to subject matter. The percent of pages falling into each subject matter field is summarized in Table 6. It is recognized that any classification procedure is inherently arbitrary and subjective. However, if the arbitrariness is sufficiently small and classification bias relatively constant, the trends of the past 20 years may be identified.[3]

What emerges from the contents of Table 6 is that the papers given at the meetings exhibited much greater subject matter change than did the noninvited portion of the *Journal*. For example, the top three noninvited categories in the 1953–1962 period were Production, Commodities, and Foreign Development. In the 1968–1972 period the same three categories occupied the top three positions in precisely the same order.

The subject matter distribution of invited papers changed considerably. In 1953–1962 the top three categories of invited papers were Production, Commodities, and Domestic Development. By 1968–1972 the distribution of the top three had changed to Domestic Development, Foreign Development, and Resources.

In general there has been a decrease in the Production and Commodities categories—although they still remain the top two noninvited categories—and an increase in the Domestic Development, Foreign Development, Resources, and Marketing categories. Marketing and Foreign Development were characterized by large percentage increases in the 1963–1967 period; however, both categories experienced declines in 1968–1972.[4]

Institutional Publishing Performance by Subject Category

A tabulation of the five schools responsible for the greatest number of pages in each of the 10 subject categories is provided in Table 7. To the degree that the articles have been appropri-

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[3] Delineation of subject categories is very arbitrary, but even greater subjectivity characterizes the classification of individual articles into the respective categories. Further complicating this portion of the analysis is the fact that articles appearing in 1953–1962 were categorized by the junior author while those in the 1963–1972 period were the responsibility of the senior author.

[4] Arnold and Barlowe [1, p. 445] provide a classification of articles by subject matter for earlier time periods.

Table 6. The percentage distribution of pages contributed by subject category—1953–1972

	1953-62			1963-67			1968-72		
Subject Category	All Papers	Invited Papers	Non-invited Papers	All Papers	Invited Papers	Non-invited Papers	All Papers	Invited Papers	Non-invited Papers
General Agricultural Economics	5.48	8.00	2.54	2.14	0.97	2.92	5.13	7.41	3.52
Agricultural Policy	9.59	9.70	9.46	10.19	12.89	8.41	7.38	6.33	8.15
Commodities: Supply, Demand, Prices	15.27	13.24	17.64	10.22	6.83	12.46	9.10	4.07	12.66
Marketing, Storage and Distribution	8.54	9.01	8.00	14.56	15.91	13.68	10.31	8.34	11.70
Production	22.29	18.23	27.04	17.05	10.80	21.17	17.66	11.66	21.90
Farm Finance, Capital, Credit	2.69	2.80	2.54	1.83	3.85	0.50	3.25	2.75	3.62
Resource Economics: Land, Water, Rec. & Environ.	7.00	7.94	5.90	5.23	4.06	6.01	9.45	12.07	7.60
Domestic Development: Human, Regional, Labor Income, Sociology, etc.	8.58	10.18	6.70	11.23	16.16	7.98	15.39	23.24	9.85
Foreign Development: Trade, Econ. etc.	10.40	10.08	10.77	14.49	15.57	13.77	12.51	13.42	11.85
Teaching, Research & Extension Methods	10.15	10.81	9.38	13.04	12.97	13.09	9.80	10.73	9.15
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

ately categorized, some idea of the relative strength of the respective universities can be obtained. The schools ranked the top five in the greatest number of subject categories were California-Davis and Purdue, each of which appeared in five classifications; Missouri, Iowa State, and Illinois appeared in the top five a total of four times each. Most of the universities ranked in the top five appeared in more than one category. Exceptions were Chicago, Texas A & M, Nebraska, Arizona, Ohio State, Kansas State, and North Carolina State.

Conclusions

Although the tables are largely self-explanatory, several factors seem to merit final mention.

Table 7. Institutional publishing performance by subject category, all papers—1968–1972

General Agricultural Economics	Pages	Farm Finance, Capital, Credit	Pages
Michigan State University	38.50	University of Illinois	38.00
Oregon State University	28.00	Michigan State University	15.00
University of Minnesota	24.00	University of California, Davis	10.00
University of Missouri	14.00	Ohio State University	8.00
University of California, Davis	12.50	Oklahoma State University	6.00
Agricultural Policy		Resource Economics	
Iowa State University	41.00	Oregon State University	45.00
Oklahoma State University	35.00	Cornell University	28.25
Purdue University	24.25	University of California, Berkeley	26.50
University of Minnesota	19.00	University of Arizona	24.00
University of California, Davis	18.50	Montana State University	21.50
Commodities: Supply, Demand, Prices		Domestic Development	
University of Illinois	52.25	University of Wisconsin	66.25
Michigan State University	34.00	North Carolina State University	66.00
Iowa State University	26.00	Pennsylvania State University	44.25
Purdue University	23.50	University of California, Berkeley	30.00
University of Missouri	22.00	University of Minnesota	26.50
Marketing, Storage, and Distribution		Foreign Development	
Purdue University	50.50	University of Wisconsin	48.00
University of California, Davis	43.50	Cornell University	38.00
Pennsylvania State University	27.00	University of Chicago	36.00
University of Nebraska	24.00	University of Maryland	29.25
Kansas State University	17.50	Iowa State University	29.00
Production Economics		Teaching, Research, Extension Methods	
Purdue University	61.50	University of Missouri	46.25
University of Illinois	51.00	Purdue University	34.25
Iowa State University	50.50	University of California, Berkeley	31.00
University of California, Davis	35.25	University of Illinois	27.25
University of Missouri	30.00	Texas A & M University	21.25

The past 20 years have seen much greater foreign participation in the noninvited portion of the *Journal,* and authors from foreign sources have now replaced the USDA in greatest number of pages published.

There is evidence of a very strong emphasis on the subject areas of Domestic Development, Foreign Development, and Resources in recent meetings. Such a change in emphasis in noninvited papers is apparent but less extreme. The subject category under which most pages appearing in the *Journal* were classified was, and continues to be, Production Economics.

In the 1968–1972 period Purdue was the top university contributor. Iowa State, the top contributor for 1953–1962, slipped to fifth among the universities. The top 10 universities for noninvited contributions to the *Journal* between 1968–1972, in order, were Purdue, Wisconsin, Illinois, California-Davis, Iowa State, Missouri, Cornell, Pennsylvania State, North Carolina State, and Michigan State.

The concentration of refereed journal articles among the major universities has decreased slightly. Precisely the opposite trend characterizes formal participation in the meetings. The pages of invited papers accounted for by individual schools ranked in the top 30 increased from 48.94 percent in 1963–1967 to 56.89 percent in 1968–1972. Perhaps a case could be made for a more widespread sharing of invited papers.

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An Economic Analysis of Agricultural Land Use Practices to Control Water Quality*

JAMES J. JACOBS AND JOHN F. TIMMONS

Sediment and phosphorus losses to streams from crop and pasture land can be reduced through production practices. The associated abatement costs to farmers are substantial and increase rapidly as the sediment and phosphorus constraints become more stringent. Distribution of these costs is determined by the type of regulation established.

Key words: **water quality; sediment; phosphorus; abatement costs; distribution of costs.**

THE INCREASE in awareness and concern for environmental quality by the public has brought all potential sources of pollutants, including agriculture, under suspect. This paper analyzes the costs (measured in terms of reductions in farm income) of changes in agricultural practices necessary to achieve various levels of soil and phosphorus in surface water leaving a watershed.

The specific objectives of this paper are: (1) to outline the data requirement for selecting and analyzing alternative levels of water quality; (2) to estimate the least-cost means of achieving particular quality levels via agricultural production practices; and (3) to determine the benefits needed to offset costs of achieving a particular level of water quality.

Methodology

The indictment against agriculture is that too much of some residuals from agricultural production activities are entering surface and/or ground waters. The principal agricultural residuals entering surface waters are soil, plant nutrients, herbicides and insecticides, and animal wastes [2]. Soil and phosphorus are the residuals selected for this study because of the magnitude of soil as a pollutant and the increased emphasis on phosphorus as a likely nutrient to control in limiting growth of aquatic plant life.

Three basic sets of empirical data are needed to answer questions regarding the level of soil and phosphorus residual in surface water and method of control. First, physical relationships between alternative agricultural production practices and soil and phosphorus losses to water need to be identified and quantified. The identification and quantification of these relationships are extremely difficult because phosphorus and soil loss occur simultaneously from agricultural and natural activities, most residuals from agriculture enter water in a diffuse manner, and the water transport mechanism embraces a multitude of interactions and transformations of the residuals received. Second, costs associated with each alternative production practice considered must be determined. Finally, benefits associated with the water quality improvements, i.e., reductions in soil and phosphorus, need to be estimated.

These three types of data suggest that an optimal water quality program for a water use area (watershed) can be approached by the following:

(1) Specifying acceptable residual levels and determining the minimum cost abatement techniques which prevent residuals from exceeding the specified limits, or
(2) Estimating the cost and benefits for incremental reductions in specified residuals in an attempt to equate incremental costs and benefits of water quality control, or
(3) A combination of the two approaches.

In this study, a combination of the cost minimization and incremental cost-benefit analysis is used. A cost minimization model is formulated to estimate the cost of reducing soil and phosphorus entering the stream from agricultural lands. Then an attempt is made to estimate the benefits associated with the reduced suspended sediment[1] concentration in the stream.

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[1] In this paper the term soil refers to losses from agri-

Empirical Model

To illustrate application of this approach to developing and costing water quality levels, the framework is applied to the Nishnabotna River Basin in Southwestern Iowa. The principal resource of the basin is its soil, namely the Marshall soil association. Agricultural land use, which includes row crops, close grown crops, and hay and pasture, accounts for 89 percent of the basin's total acreage. More than 70 percent of the basin's crop production occurs on erosive soils. Since agriculture is the major land use and most of the land is erosive, the basin provides an excellent study area for analyzing agricultural production practices and surface water quality.

The cost minimization model is formulated by dividing agricultural land in the basin among six capability classes. For each capability class it is assumed that the combination of land capability classes and production practices, including gully control structures, provide the bundle of alternative water quality improvement techniques represented by the vector (x_j), $j = 1, \ldots, n$. A summary of the production practices allowed by capability class is presented in Table 1.

To estimate the cost of reducing soil and phosphorus losses in runoff via the above production, a linear programming model was cast in the form

$$\text{Minimize } Z = c_1X_1 + c_2X_2 + \ldots + c_nX_n$$

$$\text{Subject to } a_{11}X_1 + a_{12}X_2 + \ldots + a_{1n}X_n \leqslant b_1$$

$$a_{m1}X_1 + a_{m2}X_2 + \ldots + a_{mn}X_n = b_m$$

$$X_j \geqslant 0.$$

The model determines those values of the variables x_j (the level of the various production practices by capability class) that minimize the cost of obtaining a specified level of a residual or residuals. To determine the least cost set of variables x_j, the model requires the following data:

a_{ij} = amount of the ith residual delivered to the stream from one acre of land by the jth production practice.

b_i = constraints on water quality in terms of the maximum concentration (ppm) of a residual allowed in the stream; amount of land in the various land classes; and number of gully structures allowed;

and

C_j = the opportunity cost in dollars for one acre of land under the jth production practice.

When the linear programming problem formulated above is solved, the minimum abatement

Table 1. Programming activities allowed by capability class

Programming Activities	Capability Classes I	II	III	IV	VI	VII
Conventional tillage:						
R_1*	X***	X	X	X		
R_2**	X	X	X	X		
R_1 + contouring	X	X				
R_2 + contouring	X	X				
R_1 + terraces		X	X	X		
R_2 + terraces		X	X	X		
Minimum tillage:						
R_1*	X	X	X	X		
R_2**	X	X	X	X		
R_1 + contouring	X	X				
R_2 + contouring	X	X				
R_1 + terraces		X	X	X		
R_2 + terraces		X	X	X		
Gully control structures		X	X	X	X	X
Permanent pasture	X	X	X	X	X	X

* The symbol R_1 designates the corn-corn-soybeans rotation.
** The symbol R_2 designates the corn-soybeans-corn-oats-meadow-meadow rotation.
*** The symbol X indicates those activities allowed in the various capability classes.

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cultural land and is called suspended sediment once it enters the watercourse.

cost and the treatment program for achieving this minimum cost is obtained. In addition a "shadow price" is associated with each constraint placed on a residual. These can be denoted by π_1, $\pi_2 \ldots, \pi_m$, respectively. By parametrically changing the constraints, the value Z of the minimum cost solution can be regarded as a function of the constraints. Thus, $\pi_m = \frac{\partial^z}{\partial^b_m}$ represents the incremental change in the cost per unit decrease in the amount of residual allowable. Clearly, $\pi_m \leqslant 0$ in that allowing more of a residual requires less treatment, thereby decreasing costs.

Estimating Soil and Phosphorus Losses

The universal soil-loss equation provides a procedure for computing the expected average annual soil loss from alternative land practices on a particular land area. The universal soil-loss equation is $A = RKLSCP$, where A is computed soil loss in tons/acre/year, R the rainfall factor, K the soil erodibility factor, L the slope-length factor, S the slope-gradient factor, C the cropping-management factor, and P the erosion-control practice factor [10, p. 3]. By placing appropriate values on these factors, the soil-loss equation can be used to predict soil losses under alternative production techniques.

Associated with the soil losses is the phosphorus contained in the runoff water and attached to soil particles. Since phosphorus control as a means to limit plant growth in natural waters has received considerable attention, a technique for estimating phosphorus losses under alternative production practices appears to be of major importance. In developing an equation to estimate phosphorus losses, three facts about phosphorus were given prime consideration:

(1) the positive relationship between erosion and phosphorus losses,
(2) the immobility of phosphorus in soil, and
(3) the selectivity of erosion in its removal of phosphorus.

Considering the immobility of phosphorus in soil and the selectivity of the erosion process, phosphorus losses are estimated by adding the phosphorus content in the topsoil and a selectivity factor to the soil-loss equation. Thus, the equation developed to predict phosphorus losses is $Np = A\, S_p\, E$, where Np is pounds of phosphorus loss/acre/year, A is tons of soil loss/acre/year, Sp is pounds of phosphorus/ton of topsoil,[2] and E is enrichment ratio of phosphorus, i.e., the increased concentration of phosphorus in eroded soil relative to the original topsoil.[3]

The above equations provide a methodical means for bringing the effects of rainfall, soils, topography, and land use into the computation of soil and phosphorus losses by erosion.[4]

To limit the number of activities in the program, only three land uses, two tillage methods, and three conservation practices are considered. A summary of land use activity by capability classes is presented in Table 1. For each activity, a physical coefficient specifying the per-acre soil and phosphorus loss is calculated. However, all of the physical coefficients (soil and phosphorus losses) calculated to this point for the various activities are gross-estimates of the tons of soil and pounds of phosphorus moved per acre from its original position.

Since the focus of the study is on stream quality, these coefficients are expressed as a concentration, i.e., weight of soil or phosphorus for a given volume of water. To calculate the concentration of a residual, a delivery ratio[5] (D) for the residual and the weight of a specified volume of water must be determined.[6] With the amount of the residual entering the stream and weight of a given volume of water, the concentration of the residual can be expressed in parts per million (ppm). A general formula for expressing concentration in ppm is as follows:

Concentration (ppm)

$$= \frac{Q_c}{1358.4186\ (Q_w)} \times 1{,}000{,}000$$

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[2] In the study area, phosphorus/acre and soil/acre were estimated at 1,200 pounds and 1,000 tons respectively. This gives an Sp factor of 1.2 pounds of phosphorus per ton of soil.

[3] Values for the E-factor were estimated from an equation developed by Massey *et al.* [5, p. 354].

[4] In applying the equations to a large tract of land, certain assumptions regarding soil type and topography are needed. One assumption is that Marshall silt loam, which occupies approximately 60 percent of the watershed, is the only soil type in the watershed. Another assumption, because of aggregative nature of land use data by capability classes, is that a single slope length and slope gradient are representative for land in a particular capability class.

[5] The delivery ratio is the percent of the soil (or phosphorus) eroded from its original position that is delivered to a specific point. A delivery ratio of .25 was used from Seay's study [6]; in addition the delivery ratios of .20 and .30 were also used to check its sensitivity.

[6] Water weighs 1358.42 tons/acre-foot, which is based on a cu. ft. of water weighing 62.37 pounds at 60°F.

where Q_c = quantity of constituent in tons,
Q_w = quantity of water in acre-feet.

Since the soil-loss equation gives long-term average losses (25 years), only long-term average flow is used in the study. Taking the average yearly runoff of 796,125 acre-feet [6], the equation can be reduced to:

$$\text{Concentration of suspended sediment } (ppm) = .9247 \times 10^{-3} \times Q_c.$$

While total phosphorus losses are computed from the tons of soil delivered per acre, only a portion of the total phosphorus is in a form available to plants. To determine the amount that is available, an available-to-total phosphorus ratio is developed (A/T ratio). This ratio is based on preliminary studies which indicate there is an inverse relationship between suspended sediment concentration and solution (available) phosphorus. Using these results, available phosphorus coefficients are obtained for each of the activities at alternative suspended sediment concentrations.[7] The available phosphorus concentrations were then calculated from the following equation:

$$\text{Phosphorus } (ppm) = \text{soil delivered (tons/acre)} \times \text{pounds phosphorus/ton soil} \times .46235 \times 10^{-6} \times A/T \text{ ratio.}^{8}$$

The above equations provide suspended sediment and phosphorus coefficients for each activity in terms of stream concentration. To link these suspended sediment and phosphorus concentrations with the point of use, it is necessary to describe their transport by the watercourse. In Iowa streams over 85 percent [3, p. 15] of the sediment load is in suspension and the majority of the phosphorus is bound to the suspended sediment. Therefore, the suspended sediment and phosphorus delivered to the stream are assumed to be transported to the point of use.

Having developed the physical coefficients, the next step is the derivation of the opportunity cost for each activity. To obtain these opportunity costs requires both the fixed and variable costs and the gross return for each production activity. The corn-corn-soybeans rotation was used to illustrate how opportunity costs are derived. First, the annual fixed cost of machinery and equipment is computed based on 450 acre production units and days available to perform tillage and harvest operations. Variable costs of production, which includes labor, fuel, repairs, seed, fertilizer, pesticides, and storage, are determined for this rotation and tillage method on class I, II, III, and IV land. Next, an average annual gross return is calculated for this rotation and tillage method on capability classes I through IV. Finally, there is a land charge for each capability class.

The sum of the costs and returns is the net return per acre per year for that rotation and method of tillage on a particular land capability class. For each capability class, one of the production alternatives provides the farmer the highest net return per acre and therefore has a zero opportunity cost for the other alternatives considered. The opportunity cost of a particular alternative is the difference between the net return of that alternative activity and the alternative which provides the highest net return. These opportunity costs are used as the cost coefficients in the linear programming model.

In determining water quality constraint levels and the associated benefits, certain downstream water demands (next-users) are specified. These demands are generated by a synthetic city that is located at the lower end of the basin. It is assumed that the city demands 2.5 million gallons per day (*MGD*). In addition, the in-stream uses considered are a warm water fish habitat and swimming.

The quality levels specified for these water uses are as follows:

(1) Municipal water supplies: suspended sediment 150 *ppm* and available phosphorus (as *P*) .2 *ppm* [6, p. 76 and 7, p. 24].
(2) Warm water fish habitat: suspended sediment 75 *ppm* [6, pp. 47 and 53].
(3) Swimming: suspended sediment 37.5 *ppm* [6, p. 77].

Model Application and Interpretation of Results

Because of the large differences between the lower suspended sediment requirements and the computed average annual concentration, alternative constraints on suspended sediment ranging from 10,000 to 37.5 *ppm* were set. Once these constraints were set, the model was run for each of the suspended sediment constraints, and then the phosphorus constraints were added. Solutions obtained in this manner made it possible to (1) derive total cost function for the range of quality levels considered, (2) determine the impact of phosphorus constraints on total cost and the level at which it becomes the constraining value, (3) observe the different activities present in the optimal solutions, and (4) observe the changes in the shadow price of the quality constraints (marginal cost) over the range of quality levels considered.

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[7] It should be made clear that the exact ratio of available to total phosphorus and its relevance to water quality remains to be determined.

[8] $.46235 \times 10^{-6}$ is the conversion factor to convert pounds of phosphorus to *ppm*.

Cost of Reducing Concentration of Suspended Sediment

To illustrate the computer results and their interpretation and use, the estimated costs associated with specified levels of suspended sediment are used. A summary of the estimated suspended sediment abatement costs is presented in Table 2. To obtain an average suspended sediment concentration of 10,000 *ppm,* the abatement cost would be approximately $176 thousand. This cost arises because farmers in the watershed must adopt alternative production practices to meet the suspended sediment constraint. At the 10,000 *ppm* constraint, the change in practices occurs on class IV land where pasture is substituted for a corn-corn-soybean rotation. The opportunity cost to a farmer for making the change is $5.45 per acre, i.e., the return per acre is $5.45 less with pasture. This amount multiplied by the number of acres needed to meet the constraint gives the total abatement cost.[9]

While $5.45 per acre is the cost for those farmers actually changing to pasture on class IV land, $1.19 per acre is the average cost if total abatement cost were spread over the total acres of class IV land. If total abatement costs were spread over all crop and pasture land in the watershed, the cost per acre would drop to $0.11. At the 7,000 *ppm* level, all class IV land is converted to pasture and gully controls are built. The $5.69 for class IV land consists of the $5.45 opportunity cost for changing from row crops to pasture since all class IV land is in pasture, plus $.24 per acre for gully control structures if the costs of gully control structures are spread over all acres available for such structures. The cost per acre to a farmer building such a structure is $1.58. At the 4,000 *ppm* constraint all gully control structures allowed are built and class III land is terraced. For class III land the $1.95 per acre represents $1.58 for gully control structures plus $0.37 which represents the opportunity cost of terracing class III land when the cost is spread over the total acres of class III land. The opportunity cost of terracing is $10.60 per acre. Terracing continues to the lowest constraint level of 37.5 *ppm.* In addition to total abatement costs and acres of land under each cropping practice, the results indicate the additional cost of reducing the suspended sediment concentration another unit.

The results illustrate that land use patterns can be an important factor in water quality control. The most stringent suspended sediment and phosphorus constraints were obtainable with a substantial amount of cropland in continuous row crops. However, costs to farmers are substantial.

The different per acre abatement costs pre-

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[9] The computer program gives the number of acres in each cropping practice by capability class for each constraint specified.

Table 2. Estimate costs associated with specified levels of sediment

Sediment Constraint[a] (*ppm*)	Total Abatement Cost ($thousand)	Average Abatement Cost ($/ac)	Average Abatement Cost by Capability Class[b]				Marginal Cost ($/*ppm*)
			II	III	IV ($/ac)	VI and VII	
10,000	176.4	.11	—	—	1.19	—	302
7,000	1,081.7	.68	.24	.24	5.69	.24	607
4,000	2,903.3	1.82	1.58	1.95	7.03	1.58	1,206
1,000	6,522.3	4.09	1.58	7.11	7.03	1.58	1,206
250	7,427.0	4.66	1.58	8.40	7.03	1.58	1,206
150	7,547.6	4.74	1.58	8.57	7.03	1.58	1,206
75	7,638.1	4.79	1.58	8.70	7.03	1.58	1,206
37.5	7,683.4	4.82	1.58	8.76	7.03	1.58	1,206

[a] Sediment concentrations are annual averages.

[b] Capability class I is not included in the table because there are no changes in the management practices on class I land.

sented in Table 2 can also be useful in suggesting and implementing various regulatory policies. For example, if all farmers in the watershed are deemed responsible for reducing the concentration of suspended sediment to 1,000 *ppm*, a tax of $4.09 per acre might be levied. Returns from this tax could be used to subsidize those farmers who adopt the alternative practices (gully control structures, terracing, and pasture) that achieve the sediment constraint in the least cost manner. If only the land in the capability class where the changes are being adopted is deemed responsible, then a tax of $1.58 on class II land, $7.11 on class III land, $7.03 on class IV land, and $1.58 on class VI and VII land would be needed to cover the abatement costs. Again, returns from the tax could be given to those farmers actually changing practices or to some regulatory agency in charge of water quality control for the watershed.

Distribution of the costs of sediment abatement is quite different for the two taxing schemes mentioned above. The per acre tax levied on all crop and pasture land in the watershed would distribute the costs equally over all farms regardless of acres in the various capability classes. If a tax is levied only on the land in capability classes where changes are made, a farm or group of farms with a large proportion of land in capability classes III and IV would bear more of the abatement costs than a farm or group of farms composed largely of class I and II land. This suggests that a tax levied on all crop and pasture land is likely to provide a more equitable distribution of abatement costs. The difficulty lies in determining the appropriate level of tax and a system for administering the tax.

An alternative to farmers defraying the costs of abatement is to have the water users benefiting from reduced sediment cover abatement costs. Under this scheme, a tax could be levied on water users benefiting from reduced sediment concentration, or a poll tax for the improved quality. In this case the results can be useful in indicating the level and distribution of the tax if the farmer is to be compensated for adopting the least cost abatement practices. A major problem of this scheme would be the identification of beneficiaries of the improved water. The above results reveal the least-cost system for achieving a given quality via production practices, but they do not provide evidence on water quality levels which, if achieved, would maximize benefits for all uses. Information on the costs of control practices must be complemented with information on the damages and benefits to subsequent water uses. This suggests that the delineation of benefits and damages associated with various levels of water quality is basic to an optimum system of quality management. In the case of quality control practices, this could be regarded as a "damage avoidance function"—the relationship between decreases in residuals discharged and associated benefits and damages.[10]

Benefits from Reducing Concentration of Suspended Sediment

Measurement of benefits to water users from quality control practices poses two major difficulties: quantifying the functional relationship between pollution control practices and the benefit to water uses, and placing a value on benefits to recreational uses. Because of these difficulties, benefit analysis of quality management has generally been neglected, and cost minimization has been the tool used in determining an optimum quality management system.

In an attempt to measure benefits from the reduced suspended sediments, the reduced treatment costs to the municipal water supply plant were estimated. To quantify reduced treatment costs, a physical relationship between the suspended sediment level of the raw water supply and the treatment of that supply is specified.[11] By specifying this relationship, the treatment costs associated with the quality of the raw water supply can be determined. Reduced treatment costs associated with incremental reductions in suspended sediment were calculated in two steps. The first step estimated reduced construction costs associated with changes in the average level of suspended sediment. While considerable construction cost information is available for water treatment plants of various size, little is available on the construction cost of a given plant size for water of various quality levels. However, Wanielista [9, p. 1] indicates that raw water quality should be given prime consideration in the design phase of water treatment facilities. He derived the following construction cost equations for low and medium quality sources:

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[10] This basic idea was expressed by Kneese and Bower in what they termed a "damage cost function" [4, p. 109].

[11] Suspended sediment was selected because turbidity, which can be related to suspended sediment, has been indicated as an important parameter in determining treatment [1, p. 182]. It is also frequently measured by water supply treatment facilities [8, p. 6].

Low quality source: $C = .62Q^{.57}$,
Medium quality source: $C = .52Q^{.57}$,
where
C = construction costs,
Q = water treated in MGD.

Using these equations it was possible to calculate the change in construction costs per change in suspended sediment concentration and thereby compute costs associated with various levels of suspended sediment.

Other treatment costs associated with incremental reductions in suspended sediment are the chemical costs. To derive these, eight months of daily records on turbidity and chemical dosages were analyzed; only aluminum sulfate (alum) was shown to be significantly related to turbidity. The least squares equation obtained was:

$Al = 46 + .138\,T$
where
Al = pounds of alum used per MGD,
$T = JTU$.[12]

Using this equation, it was possible to calculate the alum used at various suspended sediment levels and the associated costs.

Summing the reduced construction and chemical costs, the reduced treatment costs associated with incremental reductions in suspended sediment provide only a small reduction in the municipal water supply costs compared to abatement costs. Therefore, to justify reductions in suspended sediment for municipal water supplies on an economic basis, there must be a tremendous reuse of the water (80–400:1).

In addition to the municipal water supply, two recreational uses are assumed. Since estimates of the recreational benefits associated with various levels of suspended sediment could not be obtained, the minimum benefits needed from recreational uses to justify a specified level of suspended sediment can be obtained by subtracting the municipal treatment benefits from the abatement costs. For example, at the constraint level of 75 *ppm* of suspended sediment, the benefits to municipal water treatment are $32,554 and the agricultural abatement costs are $7,638,000. Subtracting the benefits from the costs, recreational benefits would have to increase by approximately $7.6 million to justify that constraint on an economic basis.

Summary and Conclusions

A linear programming model was developed to estimate the costs to farmers of reducing soil and phosphorus losses. In addition, an attempt was made to estimate the benefit of reduced soil losses to a municipal water supply and to recreational uses. The results should be viewed as preliminary and subject to change as additional information becomes available from further research. In particular, more reliable results on soil and phosphorus losses from agricultural practices and on benefits associated with their reduction are needed.

The results of the study indicate that agricultural production practices can be effective in reducing soil and phosphorus losses but that the costs to farmers are substantial. Distribution of these abatement costs is largely a function of the regulation system adopted. If the farmer or polluter is to bear the costs, a tax levied on all crop and pasture land in a watershed is likely to provide a more equitable distribution of costs than a tax on only that land where control measures are taken. If the water user is to bear the abatement costs, then a tax on the improved water quality would redistribute the cost from the polluter to the water user. In both cases a major problem is determining the appropriate tax and a system for administering it.

The analysis on benefits from reduced suspended sediment to a municipal water supply and to recreational uses indicates that considerable reuse of the water and large recreational benefits would be needed to justify these reductions on an economic basis.

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[12] *JTU* equals Jackson Turbidity Units.

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Strip-Mined Land Reclamation with Sewage Sludge: An Economic Simulation*

WESLEY D. SEITZ

The economic aspects of a land reclamation, sludge utilization project being operated by the Metropolitan Sanitary District of Greater Chicago are simulated. The variables influencing performance most were sludge transport costs, site preparation costs, the nitrogen budget, cropping system, and source of labor in site preparation.

Key words: **reclamation; sewage sludge; economics; simulation; Illinois.**

THE INTERFACE between agriculture and urban areas will probably continue to be an important generator of public issues. One of these issues concerns the use of the soil and the open space of agriculture as a receptor of municipal wastes. If a means of making beneficial use of the wastes in a politically acceptable manner can be found, it is clear that social welfare would be increased. This paper reports an analysis of a project that attempts to do this.

The Metropolitan Sanitary District of Greater Chicago (MSD) is charged with the treatment and disposal of the sewage waste of the city, its suburbs, and its industry. One of the products of this activity is over 900 tons, dry weight, of anaerobically digested sludge per day. In the past it was lagooned, dried, or incinerated, all of which are now impractical due to high costs or environmental quality standards. As a result, the MSD searched for other means of utilization or disposal. The search included carrying out experimental projects and supporting organized research efforts.

Fulton County, Illinois, located approximately 170 miles southeast of Chicago, has had over 50 thousand acres of its land area disturbed by strip-mining operations, and mining continues at the rate of about 2,000 acres per year [3]. There is considerable public pressure within the county to put the disturbed acreage to some useful purpose, if possible to return it to row crop production as was the case prior to mining. The soils being stripped are generally of high quality. The overburden in the county is calcareous so that acid wastes are not a problem, and the establishment of a cover crop is not particularly difficult. Also, the material is free enough from large rocks to allow the operation of agricultural machinery (at least in a zero tillage production system) if the slopes are sufficiently gentle [7].

After some contact with the MSD and preliminary explorations by public officials in Fulton County concerning the alternative possible means of utilizing the sludge to reclaim the spoil land, the MSD purchased a tract of approximately 7,000 acres. Additional land has been purchased subsequently. The general thrust of the project is that sludge will be applied on land that has been leveled and that row crops will be produced. The results would be heavier sludge applications (lower costs) than without crop production and the production of crops where not possible without sludge application, or at least the generation of higher yields [8, 10].

Research by agronomists has indicated that pollution problems would not result from this type of operation [2, 4, 9]. Heavy metals are not absorbed in the plants to levels that can be considered a problem. Agronomy research also indicates that the constraint on the quantity of sludge applications is expected to be nitrogen, which the sludge contains in both organic and inorganic form. A system of capturing all surface water and monitoring ground water has been established to minimize the possibility of pollution.

The Project and The Model

The reclamation project involves the shipment of sludge to Fulton County via the Illinois River by barge and piping it to one of three lagoons with a total storage capacity of over 8 million cubic yards. The possibility of constructing a pipeline from Chicago to Fulton County is being considered. The stripped land is leveled so that cropping operations are possible and surrounded with berms where necessary so that all runoff can be recycled in the event of water quality problems. The sludge is pumped out of the lagoons and sprayed on the prepared sites before

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planting and during the growing season, weather permitting. The crops grown will most likely be typical central Illinois row crops. The zero tillage practice will likely be used to reduce runoff and minimize the need to remove the rocks that inevitably come to the surface.

The quantity of sludge applied over the life of the project will depend on the level of organic nitrogen in the soil initially (expected to be very low relative to normal soils), on the nitrogen removal from the soil by harvested crops, and on the excess of nitrogen application over nitrogen removal possible while avoiding leaching problems.

To appraise the importance of the several variables influencing the operation of the project, a deterministic simulation model was constructed and applied with the support of the Illinois Water Resources Center [6, 7].[1] A flow chart indicating the relationships among the variables analyzed is presented in Figure 1.[2] This model must be considered an approximation in that in many cases it was necessary to determine the relationship between variables on the basis of a single observation or estimate. This is due to the fact that frequently the initial estimates available from the MSD were the only estimates available. At the time the research was conducted the actual project was in the very early stages of operation. As experience is gained, it will be possible to improve substantially the data used in the model

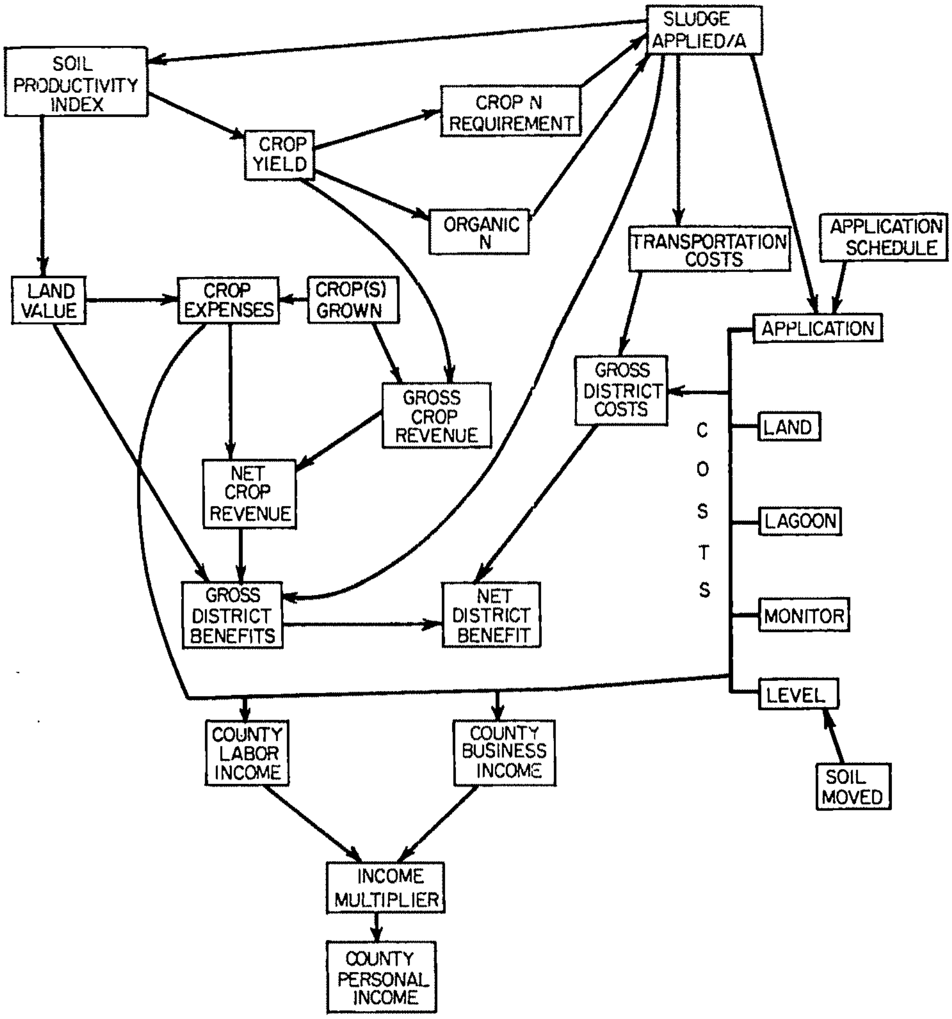

Figure 1. Flow chart of simulation model

and perhaps the model as well. At this point, however, it is possible to identify the variables that are important determinants of costs and benefits to the MSD and to the county.

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[1] The model could be characterized as a deterministic simulation model or a multi-period cost and benefit accounting model.

[2] The detailed simulation model may be obtained from the author upon request.

The model developed reflects the operation of the project from transportation of the sludge from Chicago to the site, storage, handling, and application [13] on the land. It reflects costs of leveling the land prior to application and farming, which will vary over sites, as well as a constant per acre cost for runoff control. The soil productivity index is determined by sludge applied and crop residues, which in turn determine the nitrogen present in the soil. The nitrogen requirement of the crops grown is compared with nitrogen present to determine annual sludge applications possible, if any.

Crops produced and land values determine crop expenses [5], yields determine gross crop revenues, and the difference is net crop revenue to the MSD. Increases in land values due to changes in quality and the savings over other methods of sludge disposal are added to crop revenue to determine gross MSD benefits. The costs of transportation, storage, application, leveling, land purchases and monitoring are subtracted to determine net district benefits. Crop expenses, including real estate taxes [11], and costs of operations carried out in the county determine initial county benefits, which are assumed to have a multiplier effect on county income. All costs and benefits are calculated, by year, over a 10- to 20-year horizon and are discounted.

Results Generated

In line with the objectives of the analysis those variables that have a significant impact on performance will be identified, roughly in order of their importance. Where results are indicated, they are calculated on the following set of assumptions which can be characterized as the basic solution.

Organic nitrogen present in the initial period is assumed to be 1,666.6 pounds per acre. This compares to an estimated 5,000 pounds for good corn belt soils. The ratio between nitrogen availability and use is set at 1.3. Thus, 30 percent more nitrogen is applied than removed, which is equivalent to Illinois experience on undisturbed soils. The discount rate is set at 8 percent. The cost of leveling and shaping the soil is assumed to be $700 per acre. Barge transportation is used at the actual contract rate. Costs of storage lagoons and pumping systems are also set at their actual costs.

Transportation costs

At present, the sludge is being shipped 170 miles to Fulton County by barge under a contract with an independent firm. If the results under this contract are compared with the results assuming construction of a pipeline prior to project initiation, a substantial difference of more than $2,000 per acre over a 10-year period, and more than $3,000 per acre over a 20-year period, are observed. While it is possible that future bids for barge transportation may be lower and the actual cost of the shipment via pipeline may be higher than estimated, the clear advantage of a pipeline is evident.

Site preparation costs

The cost of clearing and leveling spoil bank land as a part of any reclamation project is a subject of considerable disagreement. This project differs only in that an additional operation of constructing berms or other devices for controlling water runoff is necessary. The MSD estimates this to be a constant $300 per acre regardless of the nature of the specific site. This is added to the cost of clearing the site of brush or trees and of leveling. Depending on the roughness of the site, leveling and clearing cost is estimated to range from several hundred to several thousand dollars per acre. Most of the cost estimates for leveling operations are based on experimental, one time, projects carried out on sites of widely differing types. If this project were continued over a period of years long enough to allow contractors to gain experience under the conditions found in Fulton County, the costs per acre might be reduced. This could result from more efficient use of existing equipment or the development of new equipment.

A trade-off exists between the leveling of progressively rougher land on sites already owned and the purchase of additional sites that include less rough spoils but are more distant from the storage lagoons. This aspect was not included in the model.

In this model the costs of site preparation are included as first year costs to the MSD. These costs are included in county benefits, in total or in part, depending on whether local contractors and local laborers are utilized. The specification of local operators for such activities has a significant impact on the level of income generated in the county.

The nitrogen budget

The third most important factor is the quantity of nitrogen applied. If the only project objective were sludge disposal, the most efficient technique would likely be very heavy applications on a small acreage, essentially the creation of permanent lagoons, or at least areas that would have levels of water and nitrogen too high for crop production. If crops were to be produced without concern for nitrogen (or other) pollution problems, the sludge utilization objective could be most effectively met by operating with levels of nitrogen and water applied far in excess of that required by the crop. In fact, the optimum level of application would be such that some reduction in yield would be realized.[3] Presumably an operation such as this would create nitrogen pollution problems, although the relationship between nitrogen levels on farm land and nitrogen pollution is a subject of continuing controversy. Further, it is unlikely that the Environmental Protection Agency would issue permits for an operation of this type.

Since research demonstrating the relationships among nitrogen application, crop production, and pollution on strip mine spoils was not available, it was necessary to utilize the information available from normal soils, which can be broken into stock and flow aspects. Normal fertile soils carry a stock of organic nitrogen, a portion of which mineralizes to an inorganic form each year. In this form, the nitrogen is available to crops and is subject to leaching. Strip mine spoils in which the surface layers have been buried have much less organic nitrogen present, in some cases none of consequence. Over half the nitrogen present in sludge is in organic form, and therefore sludge applications will provide organic nitrogen, as will crop residues, which will create a stock of organic nitrogen in the soil [1].

The flow aspects of this problem involve the application of inorganic nitrogen, the loss of nitrogen through volatilization, removal in the form of crops, and possible losses in the form of runoff or leaching into the ground water. It has been estimated that on normal Illinois soils approximately one-third more commercial inorganic nitrogen is added than is removed from the soil by crops produced [14].

The potential impact of the two variables—the initial level of organic nitrogen present and the relationship between the nitrogen applied and that removed—is quite significant. If the original stock is assumed to equal levels present in normal fertile soil and the maximum allowable application of nitrogen is equal to that removed by the crops, only 53 dry tons of sludge can be applied over a 10-year period. If the original stock value is zero and twice as much nitrogen can be applied as is removed from the soil, 195 tons can be applied over 10 years. The original stock of nitrogen present is slightly more important than the relationship between annual applications and removals

Cropping systems

A variety of crop rotations, continuous single cropping, and continuous double cropping options were analyzed. Generally systems using large amounts of sludge nitrogen are the most desirable. The economic benefits from using heavier levels of sludge outweigh the differences in net revenue from cropping operations. For this reason the double cropping operations are superior to single cropping. Both of these are superior to the crop rotations.

One problem with crop rotations is that the inclusion of crops with low nitrogen requirements lowers the MSD benefits, as noted. Also, nitrogen pollution problems are an apparent threat with rotations. This is due to the buildup of soil organic nitrogen to levels higher than found in undisturbed soils through applications in the years when crops demanding high levels of inorganic nitrogen are grown. Then, when crops with low nitrogen demands are grown, more nitrogen is converted from an organic to an inorganic form than is utilized by the crop. The excess may leach into the ground water.

The cropping systems that the model suggests will perform best are: corn-rye double cropping, for grain or silage, and sorghum-sudangrass. For example, almost 50 percent more sludge is applied over 10 years with the corn-silage-rye system than with a corn-soybeans-wheat-alfalfa rotation. Data for selected crop rotations are shown in Table 1.

Labor use

Use of local labor and local contractors to carry out the physical activities of the project is an important determinant of county income. If secondary income effects are not considered (a multiplier of 1), the present value of income generated in the county over 10 years is $113 per acre when outside contractors and labor are uti-

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[3] That is, production would take place in the third stage of the production function, past the point of maximum yields.

Table 1. Total sludge applied and break-even alternative disposal costs for a 10-year period

	Total Sludge Applied (dry tons/acre)	Break-Even Alternative Disposal Cost ($/dry ton)
Corn-Rye Double Cropped	148.2	67.89
Sorghum-Sudangrass	156.7	68.23
Corn	118.2	76.03
Corn-Soybeans	111.7	77.85
Alfalfa	112.0	78.50
Corn-Soybeans-Wheat-Alfalfa	99.0	83.87

Source: [6].

lized. If local labor is used by outside contractors, it jumps to almost $500. If both local contractors and local labor are used, it increases to $626.

The existence of a multiplier will further increase these benefits. A multiplier of 1.11, as was estimated for Fulton County, would increase the $626 to $695.[4] If it equaled 2.0, the benefits would double from $626 to $1,252.

Other variables

The remaining aspects of the project are, at least in relative terms, not highly significant determinants of project performance. The costs of the storage lagoons and pumping and application systems, for example, are large, but the impact of changes of these costs over reasonable ranges is not significant. Variations in the discount rate from 4 to 12 percent did not significantly influence project performance due to the large proportion of the expenditures occurring in the first year of the project.

Selected Results and Conclusions

Since the estimates on which this analysis is based are approximate, the results are less than exact. However, some of the results are presented to provide a general understanding of the project. Based on assumptions that appear reasonable for the level of nitrogen present and crop utilization, the following can be reported. Almost 150 dry tons per acre of sludge could be applied in the first 10 years, with another 100 plus tons being applied in the following 10 years. The net present value cost of the project to the district would be about $68 per dry ton using current transportation methods and about $39 per ton if a pipeline were constructed. That is, if the costs and returns associated with operation of the project over a 10-year period are discounted to the present, they are equivalent to $68 per dry ton. Assuming that local labor and contractors are used, the project would generate economic activity in the county amounting to $600 to $1,200 per acre, depending on the multiplier.

It seems that it is reasonable to conclude that a project of this nature is economically feasible. The MSD will be able to apply significant quantities of sludge and, if the pipeline is constructed, at lower cost than under the disposal methods used previously. The county will realize benefits in that significant acreages of strip-mined land will be reclaimed and significant levels of income will be generated. It is this anticipated benefit by both parties that resulted in the initiation of the project.

Of course, additional research needs to be done. While these estimates are crude, the variables identified as important determinants of project performance are logical research subjects. The presumption of no heavy metals pollution is accepted in this analysis, but will need to be monitored, as will the nitrogen levels in the water environment. A more complete understanding of the nitrogen balance aspects of producing a wide variety of crops is needed. The project involves the heavy use of herbicides in a zero-till cropping system. More needs to be known about the physical and economic aspects of this system. Improved estimates of site preparation costs are needed, both with current techniques and alternatives which may be developed.

Research also needs to be carried out on the economics of the application of sludge to normal cropland and on the viability of this system as an alternative for small communities. If energy prices continue to increase, the price of nitrogen fertilizer will continue to rise since it is produced using large quantities of natural gas. The increased price of commercial fertilizer (and especially any shortages) will favor the use of other sources of plant nutrients such as sludge. In addition, there are socio-political aspects of the

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[4] The multiplier was estimated as follows:

$$M = \frac{1}{1-(R_r+S_s)}$$

R = proportion of consumers' income spent in local retail trade

S = proportion of consumers' income spent in local service trade

r = proportion of an increase in retail receipts received as income by persons engaged in retailing

s = proportion of an increase in retail receipts received as income by persons engaged in service trade.

•See [9].

project that are crucial to its continued operation, and these may be more important than the economic-engineering aspects [12].

While the possibility exists that problems with this operation may arise, indications are that it should be successful. It may well demonstrate that both rural and urban citizens can benefit from such a project.

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Individual Income Redistribution and Publicly Provided Irrigation: The Columbia Basin Project*

CRAIG L. INFANGER AND WALTER R. BUTCHER

The performance of publicly provided irrigation as a method of income redistribution is examined by applying fiscal incidence analysis to a representative area in the Columbia Basin Project. Results indicate the redistributional impact of public irrigation is clearly not in favor of lower income classes.

Key words: **irrigation; income distribution; reclamation programs; Columbia Basin; public program evaluation.**

ONE METHOD BY WHICH public sector expenditures policy affects the distribution of incomes is the provision of income enhancement opportunities for specific segments of society. Notable examples of programs in this domain are public education, manpower retraining, and publicly provided irrigation. By 1970 the federal reclamation program encompassed millions of acres and nearly 99,000 full-time farmers in the 17 western states [6, p. 1]. Cumulative expenditures by the Bureau of Reclamation totaled over $6 billion by mid-1970.

The reclamation program has been recognized as having important distributional elements. Kimball and Castle suggest the fundamental objectives are:

> (1) to provide opportunity for the maximum number of settlers on the land; (2) to distribute widely the government-involved, interest-free funds for irrigation; and (3) to promote the family farm as a desirable way of life. [8, p. 26]

The legal and administrative requirements of the federal reclamation program confirm the distributional concerns expressed in the program objectives. The most well-known of the legal constraints on participation is the 160-acre limitation which prohibits the delivery of irrigation water to more than 160 acres under single ownership in order to spread the farming opportunity as widely as possible. Other aspects of the program, including the repayment formula, the residency requirements, and the land price controls, also affect the distributional impact of the program.[1]

It seems appropriate to evaluate the redistributional impact of the reclamation program on personal incomes, especially in light of recent recommendations by the National Water Commission [10] and the Water Resources Council [11] for more explicit quantification of income and other effects of water projects. The approach used in this paper is to examine the redistributive impact of the largest of the reclamation projects, the Columbia Basin Project, on the distribution of incomes. This is an *ex post* analysis similar to those applied by Haveman [5] to the efficiency characteristics of projects. However, it is believed that the relationships learned through the *ex post* analyses provide a basis for inference to publicly provided irrigation in general.

An Analytical Framework

Gillespie [4] has suggested an appropriate method of analysis of the redistributive effects of public sector fiscal activities, referred to as *fiscal incidence* and defined as "the changes in relative income positions of families due to the tax and expenditure policies of the public sector" [4, p. 125]. Estimation of fiscal incidence is undertaken in three steps: (1) estimation of the distribution of benefits by income class; (2) estimation of the distribution of the tax burden by income class; and (3) determination of the redistributional consequences or the change in relative income positions. Marginally altered adaptations of the Gillespie method of fiscal incidence have been utilized in a few related studies [3, 9, 12].

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[1] The functional viability and performance of the 160-acre limitation and other program requirements have been discussed by Hogan [6].

Amount and distribution of participant benefits

Following the lead of traditional benefit-cost evaluation, the straightforward assumption is made that benefits to the participants in public irrigation projects may be measured by accounting for the significant sources and amounts of project-supplied increments to the incomes of the beneficiaries. Other approaches to benefit valuation are conceptually possible [9, 12]; however, the approach utilized in this study is most suitable when appropriate data are available.

A prerequisite to participant benefit estimation is identification of participant-beneficiaries. In the entire Columbia Basin Project there have probably been over 20,000 farm operators and land owners in the 25-year history of the project. Cost and time requirements dictated selection of a sample area, irrigation Block 42,[2] which consists of 20,882 irrigable acres and 272 full-time farm units. Water was first delivered to Block 42 in 1953; thus there is a sufficiently long history to provide good historical data on participant benefits. The block has no unique topographical characteristics that might render it unrepresentative of the project in general. Finally, the study area is located near the center of the Columbia Basin Project, which minimizes the influence of external economic factors and ties with other agricultural areas.

Data on individual farm unit ownership and operatorship were obtained, and 467 individuals were identified as participants over the period 1957–1968. These primary beneficiaries could be identified by participation mode: farm unit owners who were operators, tenant-operators, and farm unit owners who were not operators.

The amount of benefits received by the participant-beneficiaries was assumed equal to the sum of the farm income, rental income, and capital gains less irrigation district water charges and project repayments.[3] A generalized accounting model was formulated as follows:

$$PB_m = \sum_i \sum_j F_{ij} + \sum_i \sum_j R_{ij} + \sum_i \sum_j C_{ij} - \sum_i \sum_j OM_{ij} - \sum_i \sum_j RP_{ij}$$
$$(i = 1, 2, \ldots, 12; \quad j = 1, 2, \ldots, 318)$$

where

PB_m = total participant benefits accruing to participant m over the study period;
F_{ij} = net farm income for farm unit j in year i;
R_{ij} = net rental income for farm unit j in year i;
C_{ij} = net realized capital gains for farm unit j in year i;
OM_{ij} = operation and maintenance charges (O&M) for farm unit j in year i;

and

RP_{ij} = project repayments completed for farm unit j in year i.

Net farm income (F_{ij}) was assumed equal to gross receipts less estimated production expenses (except for water charges, repayments, and opportunity cost of operator labor). The calculated values for net farm income in each year were adjusted for price level changes to place all income values in terms of constant 1968 dollars. The adjustment made for the opportunity cost of farm operator labor is discussed in more detail later.

Rental income (R_{ij}), which accrues primarily to the owner–not operator group, was assumed equal to the estimated annual rental value of Block 42 farm units. These estimates were obtained from Extension Service farm management economists and private industry sources. Again, rental income values were expressed in constant 1968 dollars.

Capital gains (C_{ij}) reflect an increase in expected future income from the land. These gains are realized by whoever owns the land at the time of the sale of the land. The capital gains were measured by changes in assessed valuation (for property tax purposes) of the irrigated acreage, multiplied by the county market value/assessment ratio and adjusted for the effects of capital (irrigation system) improvements. Assessed value data were used because sale price data were very incomplete and values were needed for all land at the end of the study period when accrued capital gains were used to measure the expectation of future incomes.

A portion of the total burden of financing public irrigation falls upon the participant-beneficiaries in two forms: operation and maintenance charges (O&M) and repayment obligations. The incidence of this portion of total burden is clearly upon participants, and consequently this part of total burden was termed "participant costs."

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[2] An irrigation "block" refers to an area of land consisting of several farm units served principally by one or a closely-knit system of lateral canals and in which all land enters into the irrigation development at the same time.

[3] Detailed presentation of the benefit calculation procedure is contained in Infanger [7].

Estimated O&M and repayments were deducted from the calculated gross benefits.

Distribution of the participant benefits by income class was made possible by pre-participation income class information obtained in a mail survey of participants. This represents a significant improvement over the distribution of benefits as undertaken in related studies [2, 3, 12] because it represents the stated pre-participation income class rather than an income class inferred from property holdings or census information.

Amount and distribution of the burden

The most common method for estimating the amount of the burden associated with a particular public program is to assume the burden is equal to program expenditures [4, 12]. However, this assumption accounts only for budgetary costs of the program. The total burden to society also includes such cost concepts as administrative costs, tax collection costs, incentive to avoid taxes, and interest costs. Since detailed data are seldom available, the total gross burden of publicly provided irrigation was assumed to be equal to the total budgetary expenditures for the direct water delivery system in Block 42 and a *pro rata* share of expenditures on the main dam and delivery system; and the cumulative interest costs calculated on the budgetary expenditures not yet repaid.

Public program costs may be recouped to some extent by repayment requirements levied on program participants. In the case of public irrigation, the repayment requirement is limited by law to "ability-to-repay." These repayments represent a reduction in the total burden. The total net burden was then assumed equal to the gross burden less the value of repayments completed and the present value of the future repayment obligations.

In a manner similar to the treatment of the distribution of participant benefits, the ideal information would identify the source by income class of each tax dollar expended on a program. In reality, though, all federal taxes, except trust funds, are deposited in the same general fund account. This "pooling" of federal taxes makes it impossible to identify the source of tax dollars expended on particular programs.

To solve the problem of distribution of the burden, Bonnen [1, p. 250] insists that if "the program is funded out of general revenues, one has to assume a cross section of the revenue sources in structuring one's analysis of the distribution of the burden." This implies a proportional allocation of taxes. That is, if 1 percent of the federal revenues are expended for irrigation, then 1 percent of every individual's taxes can be assumed to be expended on irrigation. Given this assumption, the allocation of the burden to income classes is based on Gillespie's [4] work.

Fiscal incidence

The fiscal incidence, or redistributional impact, of public irrigation is determined by the amount of benefits received relative to the amount of the burden borne by respective income classes. Net participant benefits, which may be negative or positive, for each income class indicate the relative loss or gain in incomes to that particular income class of society as a result of provision of public irrigation.

Fiscal Incidence: Some Results

Amount of the benefits

The results of the participant benefit calculations are presented in Table 1. Total net participant benefits equaled $23 million for the first 16 years of the operation of Block 42 (1953 to 1968). However, this accounting of participant benefits did not include an allowance for the value of the resources devoted to the farming endeavor except farm operator-supplied capital for which a direct charge was made in the farm income computation. For the water and land resources, the value in alternative use during the study period was low enough to be considered effectively zero.[4] But an assumption of zero opportunity cost for operator labor would be untenable. Therefore, earnings in pre-participation employment were used to construct reasonable estimates of the value of the operator's labor, and this was reduced by average off-farm earnings during participation to estimate net opportunity cost of operator labor applied to the farm. Deducting the estimated opportunity cost from the individual operator income benefit resulted in a substantial reduction in total participant benefits (see Table 1). On an individual basis, subtracting

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[4] The water's value in downstream power generation was very low during the early years of project operation, and the soils in the study area have proved to have poor suitability for successful low-rainfall dryland farming. If significant positive opportunity costs had existed, irrigators' incomes would have been lowered but only if the cost was actually levied against them. Where the opportunity cost involved an externality, the irrigators' incomes might be completely unaffected by its size.

Table 1. Calculated participant benefits with and without allowance for the opportunity cost of operator labor, 1953–1968

		Amount of Benefit[a] or Cost	
Source of Benefit or Cost		Without Allowance for Opportunity Cost of Operator Labor	Net of Opportunity Cost of Operator Labor
Operator Income		$17,704,272	$10,998,021
Capital Gains		4,026,872	4,026,872
Rental Income		3,688,942	3,688,942
Total Gross Participant Benefits:		$25,420,086	$18,713,835
O&M Charges[b]	$1,947,678		
Repayments[c]	115,304	2,062,982	2,062,982
Total Net Participant Benefits:		$23,357,104	$16,650,852

[a] In 1968 dollars. Includes approximations for the 1953–1957 period when individual operator data were not available.

[b] O&M charges for the period 1957–1968. No O&M charges were levied in 1953. For 1954–1956 the O&M charges were included in the farm budget calculations of operator income.

[c] Repayments completed during 1964–1968.

opportunity costs estimates from farm income resulted in a change from positive to negative total benefits for 72 of the 310 operators. This indicates that those 72 individuals would have been better off *economically* by not participating—the earnings they "gave up" exceeded the income benefits they received from participation. This result is in agreement with those studies which indicate median incomes for farm families are well below the median incomes of urban families.

Distribution of the benefits

Calculated participant benefits were distributed among income classes on the basis of the preparticipation income distribution reported by the 197 participants who responded with income data. It was necessary to make an adjustment for differences in real income due simply to price level effects on normal incomes reported by participants who commenced at different times. To adjust income for price level, it was assumed that the 197 respondents were distributed uniformly *within* a stated income class, and the consumer price index was used to adjust incomes to constant 1968 dollars. The resulting revised income distribution of participants on the basis of time-adjusted income class is presented in Table 2.

Amount of the burden

Expenditures for the Columbia Basin Project began in 1934 and continue in limited amounts today. The fraction of the cumulative total cost attributable to Block 42 was estimated by dividing nominal budgetary expenditures for each involved service system or facility among the acreages ultimately serviced. These allocated expenditures, measured in 1968 prices, equaled $25,175,000 or approximately $1,206 of budgetary expenditures burden per irrigable acre. The total includes $3,634,000 for Block 42's share of the project service system, $4,385,000 for the East Irrigation District Service System, and $7,056,000 for the Block 42 service system.

Federal regulations do not require interest payments on the federal dollars expended in the Columbia Basin Project. Nevertheless, interest costs are a real cost to society. The difficult task of determining what rate should be utilized to measure the time value of the federal expenditures was sidestepped by choosing three alternative rates: 3 percent, 6-7/8 percent, and 10 percent. The first rate, 3 percent, was chosen because it was used in planning other features, such as hydro-power, in the Columbia Basin Project. The current rate stipulated for use in water resource planning is 6-7/8 percent [11]. And finally, several sources argue that the most appropriate interest rate for public investments is approximately the opportunity cost of capital, estimated to be 10 percent. Based on these rates, the interest component of total burden was computed and is shown in Table 3.

A portion of the total gross burden is repaid by the participants in the form of repayment obligations. The repayment obligation is limited by law to a calculated "ability-to-repay" and, in addition, repayments are spread over a lengthy period, 50 years in the case of Block 42. The net

Table 2. Distribution of participant benefits by time-adjusted income class

Time Adjusted Income Class[a]	Percent of Total Participants[b]	Participant Benefits: Without Allowance for Opportunity Cost of Operator Labor	Participant Benefits: Net of Opportunity Cost of Operator Labor
$ 0– 999	3.5	$ 350,357	$ 231,446
1000–1999	2.0	467,142	341,342
2000–2999	4.1	443,785	281,399
3000–3999	7.1	1,424,783	962,429
4000–4999	9.6	4,367,779	3,263,567
5000–5999	10.2	2,826,211	1,924,838
6000–6999	11.7	2,288,996	1,398,672
7000–7999	11.2	2,125,496	1,708,377
8000–8999	7.1	934,284	382,962
9000–9999	6.6	2,218,924	1,488,586
10,000 & more	26.9	5,909,347	4,667,234
Total:	100.0	$23,357,104	$16,650,852

[a] Expressed as income in 1968 dollars before taxes.

[b] Based on time-adjusted income class of questionnaire respondents.

effect of the repayments in reducing the amount of total net burden is shown in Table 3.

Distribution of the burden

For this study it was assumed that only federal personal income and corporate income taxes were used to finance the Columbia Basin Project and that the burden was shared among taxpayers in a manner proportional to tax payments by income class. The total net burden, distributed among income classes on the basis of the work of Gillespie [4], is presented in Table 4. Note that the absolute burden is highest for the $5,000–$7,500 income class and the $10,000 and over income class. Together, these two income classes bear over 70 percent of the total net burden.

Income redistribution

Once the amount and distribution by income class of the total participant benefits and total burden is determined, the fiscal incidence, or redistributional effects, can be ascertained. This is accomplished by comparison of the amount of benefits and burdens attributable to members of each income class. The net benefits for each income class, which may be either negative or positive, indicate the relative loss or gain in incomes *to that particular income class of society* as a result of provision of public irrigation.

The calculated redistributional effects of Block 42 are presented in Table 4. When the total burden is calculated at a 3 percent interest rate, the benefits exceed the burden for only the $3,000–

Table 3. Total net burden of Block 42 development, 1934–1968, at selected interest rates

Item	Interest Rate[a]: 3 percent	6–7/8 percent	10 percent
Budgetary Burden[b]	$25,175,000	$25,175,000	$25,175,000
Interest Burden[c]	7,849,377	28,178,338	61,270,352
Total Gross Burden	$33,024,377	$53,353,338	$86,445,352
Value of Repayments[d]	1,648,059	972,882	776,096
Total Net Burden	$31,376,318	$52,380,456	$85,679,256

[a] The rates used to determine the amount of the interest burden and the value in 1968 of the repayments completed and future repayment obligations.

[b] Budgetary expenditures expressed in 1968 prices.

[c] Compounded interest at the selected rates on the nominal amount of budgetary expenditures, less repayments completed, over the period 1934–1968.

[d] Value in 1968 dollars of the total repayment obligation for Block 42, $2,909,399.22 of which $114,922.68 had been repaid by the end of 1968.

Table 4. Income distributional effects of Block 12, Columbia Basin Project

Income Class[a]	Total Participant Benefits (000)	Total Burden (000)			Net Benefits (000)		
		3 percent	6-7/8 percent	10 percent	3 percent	6-7/8 percent	10 percent
$ 0-2,999	$ 854	$ 1,375	$ 2,301	$ 3,772	$ —521	$ —1,447	$ —2,918
3,000-4,999	4,226	2,919	4,883	8,004	1,307	—657	—3,778
5,000-7,499	4,178	5,463	9,139	14,983	—1,285	—4,961	—10,805
7,500-9,999	2,726	4,004	6,698	10,981	—1,278	—3,972	—8,255
10,000 and more	4,667	17,422	29,145	47,781	—12,755	—24,478	—43,114
Totals:	$16,651	$31,183	$52,166	$85,521	$—14,532	$—35,515	$—68,870

[a] Time-adjusted income class expressed in constant 1968 dollars before taxes.

$4,999 income group. This indicates a redistribution of income from the lowest and highest income groups to this income group. The lowest income group bears more in burden than it receives in benefits. If a liberal definition of "poor" is used, for example $0 to $4,999, then redistribution is favorable to the "poor" at the 3 percent rate of discount. At the 6-7/8 and 10 percent rates, the net benefits are negative in all cases.

It is important to note that the redistributional pattern is clearly against the poorest income group. From society's viewpoint, the $0 to $2,999 income group is paying a good deal more in taxes than it is receiving in benefits from the public provision of irrigation. Some individuals from this group are net gainers, but their gains are more than offset by the expenditure and interest burden that falls as taxes on non-participant members of the same income class. This income group as a whole would be, *ceteris paribus,* better off without the public reclamation program.

Conclusion

It can be concluded that, based on this analysis of a representative area of the Columbia Basin Project, the fiscal incidence or income redistributional impact of publicly provided irrigation is clearly not in favor of the poor—the lowest income group consistently experiences negative net benefits. This conclusion is not unlike Gardiner's [3] concerning a Canadian irrigation project but stands in contrast to Freeman's [2] conclusion regarding six small Bureau of Reclamation projects Freeman concluded, "If the basic data are accurate, the major redistributive effects of the six sample projects have been in the socially desirable direction" [2, p. 96].

The present conclusions must be tempered by the fact that income redistribution was but one of the goals in the initiation of the Columbia Basin Project. Other factors such as employment creation, regional income redistribution, and political considerations acted as objectives in project development. Finally, the redistributional pattern might have been much different if the reclamation program constraints on participation —160-acre limitation, owner residence, and excess lands disposal—had not been eroded in the face of efficiency dictates. But in the absence of those concessions to economic efficiency, the overall net benefits might have been even more strongly negative than they were. This reflects the dilemma of the income opportunities approach to income redistribution. The most effective realization of program opportunities often is made by members of middle and upper income groups. Provisions that exclude or limit their participation in order to save opportunities for the needy are apt to hurt overall financial success of the project. Unswerving dedication to redistribution objectives is thus apt to conflict directly with objectives of economic efficiency.

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Communications

AGRICULTURAL ECONOMICS IN A LESS EXPANSIBLE ECONOMY

Conceptual formulations and analytical skills of both general and agricultural economists have implicitly reflected an economy of a rather fluid production response in both static resource allocation and dynamic development. Relationships in supply functions have been reasonably elastic, while investment has yielded economic growth.

There is evidence that some physical resources important to the economy and to modern technological agriculture, particularly fuels and various minerals, will not be as plentiful henceforth as previously. To whatever extent this proves true, certain consequences will follow. Their intensity will be roughly proportionate to the degree of resource change.

One consequence for the economy as a whole will be manifest in gross productivity, as growth slows or even reverses. This in turn will weaken the case for using fiscal stimulation to relieve cyclical unemployment, improve living standards, and mitigate maldistribution of income. Issues surrounding income distribution are particularly likely to blaze up in a more nearly static economy.

If basic resources prove less plentiful, a serious question will arise as to whether the institution of the market will continue to be acceptable as a means to allocate factors of production. Prospects are that non-market devices will be used more in the future. The texture of economic analysis and of policy for agriculture will be put under stress of change, not because analytical techniques and policy design are irreversible but because economists' thought patterns nearly are.

Diminished availability of industrial materials would shift the supply curve for farm products to the left, individually and in the aggregate. Chronic overproduction would be less likely than in the past, but short-term instability would continue unabated. Land as a basic resource would be subjected to more non-market controls. The doctrine of relatively free international trade in farm products would become harder to hold to. Issues relating to agricultural economics in a less expansible economy will be sketched in more detail below.

Non-Farm Resources in Modern Agriculture

The literature of the development of modern agriculture is now ample.[1] The interrelation between institutions, resources, and productivity has been appropriately recognized. Running through virtually all modern technological development, however, is intensification through increased utilization of resources of industrial origin. This intensification is as visible in the Green Revolution in South Asia as in the corn farming of Iowa.

Significantly, almost all the metals, fuels, chemicals, and fertilizers so utilized come from stock (depletable) resources. The U. S. and many other nations have been shocked into awareness that these resources are not as plentiful as they once were. As Raup puts it, "we have picked the 'low-hanging fruit' first" [6, p. 19].

A conceptual objection is sometimes raised to the thesis of a decreasing resource base, on grounds of the principle of conservation of matter. The first law of thermodynamics states that matter and heat transform but nothing is lost. By inference it can be said that our new deficiency is not of resources but of ingenuity in using them. But the second law of thermodynamics adds that heat only goes from hot bodies to cold, or as Schlegel expresses it, "never uphill" [8, p. 475]. Georgescu-Roegen strikes an analogy that there are graduated stages in a resource's susceptibility to man's management, and most industrial processes transform from more available to less available forms [3]. For the present at least, we are not capable of recovering transformed matter such as spent petroleum fuel.

So long as appreciable tightening of the resource base is accepted as valid and only general conclusions are sought, quantification is not necessary. Consequences can be calibrated according to whatever peril coefficient each person may choose to apply.

The Growth Tradition of Classical Economics

It is noteworthy that classical economics came into being during a historical period of grand possibilities for productivity and growth. It was a time of exciting developments in science and of Europeans' conquest and occupation of new continents.[2,3]

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[1] Illustrative anchor points of the U. S. literature are the modest portrayal of 1954 by this author [2] and Pavelis' more profound 1973 study [5]. Capstone to worldwide investigations is perhaps Ruttan's article on induced technical and institutional change [7], which built on previous work to which Hayami notably contributed (e.g., [4]).

[2] This was noted in "Man, Resources, and Economic Organization" [1].

[3] The same events gave rise also to protest formulations in economics, as those of Marx and Proudhon.

However, growth was not often explicitly specified. Paradoxically, one of the first classicists to outline a growth theory, Malthus, was notable for a pessimism that has become a household word. But the idea that economic forces will function developmentally permeates classical writings and neo-classical as well.

Significantly, market forces were seen as adequate to allocate not only a bundle of fixed resources but developmentally expanding ones. As neither land nor minerals can truly be produced (created), the thesis translated into regarding activity to gain access to those resources and make them usable as constituting their production. For several centuries new resources were so plentiful that their value was indeed largely fixed by the cost of developing them. Granted, Ricardo instructed about rent of super-marginal land, but (1) economists have remained confident that valuation in the economy takes place at the no-rent margin while (2) most western nations have taken forceful steps to provide cheap access to both land and minerals, including subsidization, so as to minimize monopoly pricing and rent. There has probably been more concern about institutional monopolization than about a natural monopoly of scarce resources.

Macro Application: Secular and Cyclical Policy

Secular policy

An expanding economy has long been a goal of national policy. Objectives have included the reduction of barriers to individual opportunity (the frontier thesis), and mitigation of inequitable distribution of wealth and income.

The latter results as all persons share in incremental national product. Furthermore, insofar as basic physical resources are kept abundant and cheap, exorbitant rents and huge rentier incomes, always inequitably distributed, are avoided.

Cyclical policy

The Keynesian policy to expand the economy cyclically to relieve short-term unemployment obviously is appropriate only if in fact the economy is quickly expansible. Otherwise inflation is the principal outcome.

Micro Application to Agriculture

A high macro expansibility is reflected at various micro levels also. At the level of all agriculture the availability of industrial resources in an almost perfectly elastic supply function has gone far to account for agriculture's growth. The liaison extends also to giving modern agriculture an intermediate-term responsiveness that breaks its traditional shackles to weather and other natural phenomena, which had anciently made consumption subservient to uncontrollable fluctuations in supply. On the other hand, modern agriculture has proved subject to a cyclical instability that bears an industrial rather than agrarian stamp. It is often charged to intermediate-term fixity of investment in some capital inputs.

Implication: 1. General Economic Policy

Probably the most obvious and unchallengeable implication of any appreciable tightening of the resource base is to narrow the applicability of fiscal stimulation policy. Selective expansion of productive plants will continue but indiscriminate stimulation will not. Resource conservation may gain more status.

Not least among the possibilities for new policy directions is the negative one of capitulation—an abandonment of long-standing goals for high economic activity and wide sharing in it. A hard-line economic policy to restrain inflation, for example, would exclude a substantial part of the population from active, rewarding employment.

Implication: 2. Pricing of Factors

Use of market forces to price factors was the most aggressive idea in the classical design, even as it has been a bastion of the economic system. To move away from it would bring resistance and repercussion.

The hard fact is that as factors become more scarce (in the sense of the position of their own supply curve), it is doubtful whether market forces can be relied on so exclusively to establish price and thereby determine eligibility to receive income. Market pricing then yields a very high component of rent or rentier income to resource holders. Rentier income carries the moral connotation of being unearned, and it tends toward concentration and inequality.

Furthermore, market pricing of scarce resources can impede their optimal utilization and reduce gross productivity. In some countries wealthy untaxed landowners leave good farmlands uncultivated. Even in the U. S., attractiveness of farmland for hobby farming and for income tax shelter probably, on balance, reduces intensity of utilization. Rising prices of farm products may of themselves be output-stimulating,[4] but inflation of value of farmland can have the opposite effect.[5]

Income-capitalization valuation of farmland often fails to protect society's need to avoid irreversible conversion of farmland into other uses. In this context differential assessment policies are proposed. Closely akin is zoning authority to guard against any market-directed uses of land that are not in the long run public interest.

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[4] This is not universally true. The corkscrew (backward sloping) curve of labor supply can apply to farmers as readily as to other workers.

[5] The whole subject of what happens when so much of total return to agriculture consists of capital gains deserves more analytical attention than it has received. The suspicion is that an incentive arises to "produce" (realize) capital gains; and the subject becomes a burning tax policy issue.

Implication: 3. Pricing of Scarce Industrial Inputs

Unfortunately for agriculture, not only has the domestic supply function for petroleum and natural gas apparently become highly unresponsive and inelastic, but their aggregate demand, reportedly, is inelastic too. Petroleum pricing in 1973–74 provided an example of capacity to generate high rents and of accompanying issues over pricing policy. At that time crude oil production from established wells was being sustained at the controlled price of about $3.00 per barrel, even as prices for some stripper wells and new production soared to $10.00 to $12.00. Decontrol would have lifted all prices close to the latter mark, assuming demand to be as inelastic as alleged. The result would have been to generate enormous windfall profits to established producers and to set in motion a new wave of inflation as higher oil prices worked their way through the economy.

As a heavy user of these and similar industrial products, agriculture is highly sensitive to policy for their pricing and distribution. If agriculture must pay prices reflecting the full potential for rent-yielding exploitation, costs of farm production will increase significantly.

Implication: 4. Transport Cost and Location of Enterprise

Higher prices for petroleum will likely affect agriculture more profoundly through higher costs of transport than through higher prices of motor fuel for direct farming operations. More costly transport will in turn reshuffle the location and other dimensions of individual farm enterprises.

Cheapness of transport in past years has helped to get bulky industrial materials to farms, fertilizer for example. It has allowed farm enterprises to seek their most hospitable climes. It has been friendly to factory-style feedlots, as it facilitated assembly of feedstuffs. It has relaxed the age-old rule that bulky products of farming must be initially processed close at hand.

Substantial rise in cost of transport would relocate much production and processing. It might wreak havoc with some established patterns. Milk cows (and fresh vegetables too) could move back closer to cities!

Implication: 5. Commodity Price and Income Equilibrium

For more than a generation production control programs have been applied intermittently to various products of agriculture notable for use of industrial resources in production and inelastic demand at the farm. As of 1974 those same commodities were not subject to production control. They were excused therefrom not because their demand or supply had become more fluidly elastic, which would have been highly encouraging, but mainly on account of happenstance developments.[6] According to the argument of this paper, the supply function is being forced into less elasticity, not more; and although chronic overproduction (in the popular sense of the word) is less likely, the situation could induce more short-term variability in prices and incomes, not less.[7] Not only farmers remain sensitive to unstable prices, but consumers too—the latter increasingly so, it appears.

Critics of land retirement programs have declared the illogic of trying to control farm output by regulating acreage alone when industrial inputs have entered agriculture so readily. If those inputs become less available, the role of land will be comparatively enhanced. Not only will short-term orchestration of acreage set-asides make more sense than before, but longer-term protection of land resources will gain more acceptance.

The engaging possibility also arises that if a resource such as petroleum should be held under some form of allocation, the terms of allocation would affect agriculture's short-term equilibrium, whether by chance or by choice.

Implication: 6. Foreign Trade

The notion of a free market for factors of production has been carried forward in a classical faith in the principle of international free trade. If a nation were to match current pricing of factors against a discounted reservation value for future generations, new categories would likely be coined for classifying commodities traded, such as energy-intensive vs. -extensive, and perhaps scarce-resource-intensive vs. -extensive. It might be rational to calculate how much irreplaceable resource is lost in exports, and reciprocally to estimate the resource value of imports. It is conceivable that negotiated trade with a high basic-resource vector will come into prominence.

Foreign relations and humanitarian considerations can continue to influence trade policy. The U. S. is still relatively well endowed with resources. Ought we therefore to husband them selfishly? Taking grains as an example, there may be little foreign-relations or humanitarian component in deciding to sell them to Europe for feeding to livestock there. But grains exported to LDC's for direct human consumption can literally be life-saving.

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[6] It could be said that resurgent exports have added elasticity to demand. This might be true; but a more accurate statement is that floating exchange rates, state trading for some products, and a host of transitory circumstances have made export demand highly uncertain. Not the slope of its curve but its shiftability best characterizes export demand for U. S. farm products.

[7] Absent from this article is any reference to demand. If demand for various products were elastic enough, changes in the supply function would be less damaging. The usual assertion of a welfare goal of serving customers' wishes implies considerable inelasticity to demand for basic consumption goods. Probably in the more Spartan economies demand for basic necessities is inelastic indeed. But demand is not immutable; it might change appreciably in a new resource situation. The subject invites more inquiry than it has received in literature.

Implication: 7. Population Policy for Agriculture

Not long ago it was a creed that releasing workers from farming was in both their and the national interest. Empirical evidence on employment experience for *émigré* farmers proved disquieting. Now, a changed resource situation promises to jeopardize many forms of urban employment and could bring serious unemployment, not because unemployment is endemic to the situation but because accommodation will prove difficult.

The former balance between labor- and capital-intensive employment will be re-weighted. Will it become desirable to seek more rather than less employment in agriculture? This is a possibility.

Implication: 8. Meaning to Institutions, Including Government

It is well known that imperfect competition can display a kind of superficial scarcity and put more slope into supply and demand curves. This article, however, relates to fundamental changes in natural resources.

Competitive structure nonetheless has a bearing. Tighter resources will increase the power position of oligopolies having access to remaining resources and will dissipate the power of those lacking protected access.

The biggest institutional implication is to the process of government. Any material reduction in the resource base will expand the role of government at all levels. A decentralized, resource-plentiful market economy is ideal for minimum government. Any departure therefrom brings bigger government.

A moral follows, calling for more attention to processes of government. A nation that denied a need for much government was justifiably indifferent to its cultivation. A resource-short nation cannot remain indifferent. It must take conscious steps to improve its capacity for self-government.

To this admonition is added a Moses-like warning: failure to do so will not avoid a larger government role; it will only remove its democratic element.

And if the science of economics lends its resources, it will return closer toward its antecedent of the science (and art) of political economy.

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U. S. GRADUATE STUDENTS FROM LESS DEVELOPED COUNTRIES

Early in 1974 the International Committee of the AAEA in collaboration with the Research and Training Network of the Agricultural Development Council and with financial assistance from the Rockefeller Foundation sponsored a series of three workshops to review U. S. training and related research activities for LDC (Less Developed Countries) students. The 51 participants were drawn primarily from agricultural economics departments of U. S. universities along with representatives of government and private agencies interested in U. S. training. The papers, reports, and discussions emerging from the workshops provided the framework for a special session on the topic at the annual meetings of the AAEA at College Station, Texas, in August 1974.

In preparing for the workshops an effort was made to secure some basic information regarding the graduate student population from the developing countries, now studying in the United States in this special field: their numbers, locations, countries of origin, and sources of funding. There is a startling lack of such basic data.

The tables that follow represent a first and imperfect summary of information secured on short notice from 55 departments out of 61 polled. To the standard list of state universities were added six private universities possessing departments of economics where graduate training is available in the economics of agriculture.

The data collected were simple in the extreme. They suffer from certain ambiguities, however:

One, a number of the major universities have both departments of agricultural economics and of economics. Only the departments of agriculture and resource economics were polled even though there may be LDC students in sister departments who are concerned with and enrolled in programs related to the economics of agriculture.

Two, an arbitrary distinction is made between students entering at the Master's and at the Doctoral level. This is somewhat misleading as significant numbers of students who enter graduate school at the Master's level continue through the Ph.D. This survey indicates the students' status only at the time of entry.

Three, the attempt to identify students from "LDC" countries raises the usual problem of definition. The inclusion of Israel, Spain, Puerto Rico, and Japan is as open to question as is the omission of certain European countries which might not qualify as "developed" in the view of some.

Four, the sources of financial support could not be precisely determined. Only the major source of funding is revealed in the survey, yet there are students who receive support from more than one source. For example, a student may supplement an assistantship or a scholarship with personal funds or with aid from his own government. Equally unclear is the degree to which AID funds may be involved both in departmental assistantships as well as in the fellowship support provided by such agencies as IIE, AFME, AAI, and AFGRAD.

What the survey does reveal without question is that a significant percentage of graduate students studying in fields related to the economics of agriculture come from LDC countries. Overall, these students represent close to 30 percent of the total, and in particular departments that percentage rises to more than 50 percent. The presence of such a large number of LDC students in U. S. graduate programs, now and in the future,[1] underscores the importance of continued efforts to improve and enhance their professional training at the host universities. Toward this

Table 1. Totals reported from 55 departments indicating number of entering graduate students, LDC graduate students, and LDC students' degree program distribution

	1969–70	1970–71	1971–72	1972–73	1973–74	Totals
All Entering Graduate Students	1010	983	1029	1020	1052	5,094
LDC Entering Graduate Students	269	295	284	297	335	1,480[a]
LDC Students in M.S. Programs	162	168	163	188	216	897[b]
LDC Students in Ph.D. Programs	107	127	121	109	119	583[c]

[a] The 1480 LDC Students represent 29.05 percent of all Entering Graduate Students.

[b] Of the 1480 LDC Students, 60.61 percent enrolled as M.S. candidates.

[c] Of the 1480 LDC Students, 39.39 percent enrolled as Ph.D. candidates.

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[1] The survey shows a rising trend of LDC student enrollment over the past five years. One question mooted in all three workshops was whether this upward trend will continue. Many think it will be reversed due to such factors as the rising cost of U. S. graduate education, the new and restrictive INS regulations for student visa petitioners, and the continuing shortage of funds for the support of international graduate training.

end, the AAEA should, it seems to me, take steps to secure more detailed information regarding this student group.

The author is grateful for the helpful cooperation and assistance of those 55 departments which responded to the questionnaire and provided the information included in Tables 1–4.

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Table 2. 1,480 LDC students' distribution by 80 countries of origin, 1969–1974

Asia		Africa		Middle East		Latin America	
Afghanistan	9	Cameroun	7	Algeria	1	Argentina	33
Bangladesh	6	Ethiopia	49	Cyprus	4	Bahamas	2
Burma	1	Ghana	22	Egypt	10	Bolivia	13
Cambodia	5	Ivory Coast	2	Greece	11	Brazil	122
Fiji Islands	1	Kenya	14	Iran	50	Chile	29
Hong Kong	8	Liberia	4	Iraq	8	Colombia	50
India	68	Nigeria	57	Israel	4	Costa Rica	11
Indonesia	28	Rhodesia	4	Jordan	14	Cuba	10
Japan	4	Sierra Leone	8	Kuwait	4	Dom. Republic	14
Korea	73	Somali	1	Lebanon	12	Ecuador	8
Malaysia	34	So. Africa	8	Libya	10	El Salvador	6
Nepal	13	S.W. Africa	1	Morocco	5	Jamaica	4
Okinawa	5	Swaziland	1	Saudi Arabia	17	Guiana	5
Pakistan	44	Tanzania	11	Spain	2	Guatemala	6
Philippines	30	Uganda	13	Sudan	10	Honduras	7
Singapore	3	Zaire	13	Tunisia	16	Mexico	52
So. Vietnam	12	Zambia	3	Turkey	38	Nicaragua	27
Sri Lanka	8			Yemen	3	Panama	4
Taiwan	93					Paraguay	6
Thailand	135					Peru	26
						Puerto Rico	1
						Surinam	1
						Trinidad	4
						Uruguay	4
						Venezuela	18
	580		218		219		463

Table 3. 1,480 LDC students' distribution by sources of financial support, 1969–1974

					Percentage of Total LDC Group
1. U. S. Government Agencies				354	23.9
A.I.D.			339		
Fulbright			12		
Military			3		
2. U. S. Universities				340	22.9
Departmental Assistantships			275		
Other University Grants			65		
3. Self Support				283	19.1
4. U. S. Foundations & Non-Profit Agencies				243	16.4
Ford	83	A.A.I.	3		
Rockefeller	15	AFGRAD.	10		
Agric. Dev. Council	39	ICETEX	4		
I.I.E.	39	Asia Fdtn.	3		
A.F.M.E.	12	African-Amer. Inst.	7		
L.A.S.P.A.U.	8	Other	20		
5. Foreign Government Agencies				196	13.2
6. Inter-Governmental Agencies				44	2.9
F.A.O.	17	UNESCO	17		
O.A.S.	9	I.B.R.D.	1		
7. Not Indicated				20	1.3
				1,480	100.0

Table 4. Distribution by universities of All Entering Graduate Students and percentage from LDC, 1969–1974

University	Department	Entering Graduate Students	Entering LDC Graduate Students	Percentage of LDC Students
1. Chicago	Economics	277	86	31.1
2. Iowa State	Economics	270	57	21.1
3. Vanderbilt	Economics	260	171	65.8
4. Yale	Economics	221	57	25.8
5. No. Carolina State	Economics	205	45	22.0
6. Michigan State	Ag. Econ.	200	90	45.0
7. M.I.T.	Economics	153	22	14.4
8. Cornell	Ag. Econ.	141	36	25.5
9. Utah State	Economics	136	47	34.6
10. Illinois	Ag. Econ.	132	30	22.7
11. Missouri	Ag. Econ.	129	29	22.5
12. Arizona	Ag. Econ.	127	30	23.6
13. Wisc. (Madison)	Ag. Econ.	126	66	52.4
14. Calif. (Davis)	Ag. Econ.	115	34	29.6
15. Ohio State	Ag. Econ.	113	47	41.6
16. Maryland	Ag. Econ.	109	17	15.6
17. Kansas State	Economics	108	20	18.5
18. Michigan State	Res. Dev.	104	17	16.4
19. Tennessee State	Rural Dev.	104	10	9.6
20. So. Dakota State	Ag. Econ.	98	5	5.1
21. Texas A&M	Ag. Econ.	94	15	16.0
22. No. Dakota State	Ag. Econ.	94	19	20.2
23. Florida	Res. Econ.	92	38	41.3
24. Colorado State	Economics	91	25	27.5
25. Texas Tech.	Economics	90	36	40.0
26. Calif. (Berkeley)	Ag. Econ.	90	24	26.7
27. Minnesota	Ag. Econ.	89	29	32.6
28. Oregon State	Ag. Econ.	87	29	33.3
29. Kentucky	Ag. Econ.	75	34	45.3
30. Wash. State	Ag. Econ.	71	20	28.2
31. Hawaii	Ag. Econ.	70	41	58.6
32. N. Mexico State	Ag. Econ.	69	20	29.0
33. Penn. State	Ag. Econ.	65	17	26.2
34. Georgia	Ag. Econ.	65	26	40.0
35. Purdue	Ag. Econ.	63	26	41.3
36. Montana State	Ag. Econ.	63	14	22.2
37. Stanford	F.R.I.	58	18	31.0
38. Tennessee	Ag. Econ.	58	9	15.5
39. Nebraska	Ag. Econ.	57	10	17.5
40. Miss. State	Ag. Econ.	54	19	35.2
41. Virginia Poly.	Ag. Econ.	47	13	27.7
42. Mass.	Ag. Econ.	44	20	45.5
43. Louisiana State	Ag. Econ.	43	15	34.9
44. Maine	Ag. Econ.	42	1	2.4
45. Clemson	Ag. Econ.	40	0	0
46. Wyoming	Ag. Econ.	40	3	7.5
47. Conn.	Ag. Econ.	34	12	35.3
48. Rhode Island	Res. Econ.	32	5	15.6
49. Rutgers	Ag. Econ.	31	5	16.1
50. Vermont	Res. Econ.	25	3	12.0
51. Nevada	Res. Econ.	24	2	8.3
52. Idaho	Ag. Econ.	24	8	33.3
53. Arkansas	Ag. Econ.	23	3	13.0
54. Delaware	Ag. Econ.	22	4	18.2
55. Auburn	Ag. Econ.	1	1	100.0
	TOTALS	5,094	1,480	29.05

ON APPRAISING ENVIRONMENTAL INSTITUTIONS: COMMENT*

Jim Seagraves' recent article, "On Appraising Environmental Institutions" [11], comes at a critical time in the evolution of resource economics. The National Water Commission has recently released the results of five years of deliberation [6], the National Commission on Water Quality—which was created by the 1972 amendments to the Federal Water Pollution Control Act—is beginning its investigations, and the emerging energy situation promises to result in many new economic problems. These and other recent events have profound implications for environmental institutions and underscore the need to develop a clear concept of institutions and of institutional economics.

While the Seagraves article is apparently an attempt to help define an analytical approach for assessing environmental institutions, the opinions and conclusions presented are insufficient as a general discussion of institutions and because of their confusing nature are not even adequate as an effort to articulate a problem setting whereby economists might gain an understanding of important research opportunities. This fundamental confusion threatens the intellectual base of any serious economic analysis of institutions.

A Source of Confusion

At the outset, Seagraves borrows from Schultz [10] to relate the induced-innovations hypothesis to that of institutional change. In drawing on Schultz he presents a taxonomy of "Institutions that Render Services to the Economy"—a confusing conglomerate of both "rules of the game" and organizations. More specifically, the list includes: (1) a medium of exchange—money; (2) rules for transactors—futures markets, contracts, share tenancy, inheritance laws, seniority, and property; (3) private organizations that operate according to a set of special enabling rules—cooperatives and corporations; (4) programs of private and public organizations that operate according to a set of special rules—insurance and public social security; and (5) public organizations that dispense goods and services—highways, airports, schools, and agricultural experiment stations.[1]

While it may be relatively easy to conceptualize rates of return for the services provided by highways, airports, schools, agricultural experiment stations, social security programs, insurance, and futures markets, the principle of equi-marginal returns becomes extremely tenuous when we turn to money, contracts, share tenancy, cooperatives, and corporations (the latter two as legal forms of enterprise rather than as specific organizations dispensing particular goods and services).

Unfortunately, Seagraves' reliance on Davis and North [5] is not particularly helpful in this regard. Drawing on their work, Seagraves asserts: "New knowledge, prices, or rules of the game show up as economies of scale, externalities, market failures, or political pressures which suggest benefits that can only be captured by some change in the arrangemental structure" [11, p. 617].

From this we are left with the notion that new rules of the game—which are themselves institutions—precipitate change in the "arrangemental structure"—also institutions. While indeed true, this circularity is confusing and must be analyzed. The confusion likely to result from Seagraves' treatment of institutions can only mean a situation in which economists are prevented from developing a clear and unambiguous concept of institutions and of the content of institutional economics.

On Institutions and Institutional Change

Ciriacy-Wantrup has defined an economic institution ". . . as a social decision system that provides decision rules for adjusting and accommodating, over time, *conflicting* demands (using the word in its more general sense) from different interest groups in a society" [1, p. 1319]. Much earlier, John R. Commons defined institutions as: "collective action in restraint, liberation, and expansion of individual action" [2, p. 73]. In Commons' earliest work of popular appeal, institutions were defined in conjunction with working rules. To him such a rule indicates what ". . . individuals *must* or *must not* do (compulsion of duty), what they *may* do without interference from other individuals (permission or liberty), what they *can* do with the aid of collective power (capacity or right), and what they *cannot*

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* Sincere appreciation is extended to Sandra S. Batie, Bruce R. Beattie, Richard C. Bishop, C. Dirck Ditwiler, Alan Randall, and A. Allan Schmid for assistance in better articulating my position.

[1] While Schultz refers to organizations in this latter category as dispensing "public goods or services," this is not strictly in accord with conventional welfare theory where a "public" good is taken to mean a good or service that once provided is available to all without possibility of individual exclusion. Law and order, absence of communicable diseases, and national defense are traditional examples. Schultz's "public goods and services" are more consonant with Steiner's definition: "Any publicly induced or provided collective good is a public good" [12, p. 7]. By "collective good" Steiner means those situations in which ". . . some segment of the public collectively wants and is prepared to pay for a bundle of goods and services other than what the unhampered market will produce" [12, p. 7]. While highways, airports, and schools fit the Steiner (Schultz) definition of public goods, they do not fit the traditional definition.

expect the collective power to do in their behalf (incapacity or exposure)" [3, p. 6].[2]

To Commons the present outcome of any society is the end result of rights of property and powers of government which have been ". . . fashioned and refashioned in the past by courts, legislatures and executives through control of human behavior by means of working rules, directed towards purposes deemed useful or just by the law-givers and law interpreters" [3, p. 378].

Thus, we see that institutions comprise the working rules wherein conflicting social demands are reconciled. Do I have the right to obstruct your view with my high fence, or do you have the right to force me to look at your cluttered yard? Do railroads have the right to start range fires, or do ranchers have the right to abide only those fires that are "acts of God"? Do apple orchardists have the right to a fungus-free future, or do owners of red-cedar trees have the right to grow their trees at will? We could go on and on.

Institutions are social mechanisms—and economic institutions bestow streams of monetary gains and losses on different groups and/or individuals through time. Institutions do not change through the normal signals of the marketplace—namely supply and/or demand prices—but through pressures in the political arena. Ciriacy-Wantrup reminds us that Marx, Engels, and Kautsky all recognized that the demand for institutional change by one segment of society is virtually always opposed by a demand for the status quo—or a change in the opposite direction. To quote Ciriacy-Wantrup: "Economic institutions conceptualized as social decision systems provide decision rules both for the use of resources and for the distribution of the income stream derived from such use. This distribution has strong effects on the demand for institutional change. But such income effects are frequently just the opposite of those claimed by the doctrine [Schultz's] under discussion. In other words, the demand for institutional change is increased if the income stream of a social group is decreased absolutely or relatively" [1, p. 1320].

This stands in contrast to the Seagraves (Schultz) view of institutional change and—most importantly—accords more with reality. This will be discussed in more detail in the following section.

The Interface of Institutional Economics and Resource Economics

The divergence between the Seagraves position and that taken in the preceding section can perhaps best be demonstrated in the following way: taking institutions as working rules, consider first those forces which are brought to bear on the prevailing set of rules—that is, pressure which results in a given configuration of rules at a given time. Second, consider the implications of those working rules on the nature of ensuing transactions. This can be facilitated by reference to Figure 1. Here the working rules are depicted as representing one point on a circle that goes to transactors and back to the working rules. Both transactors and nontransactors use their political and economic power to exercise influence over the working rules.

Economic research that focuses on the segment A-B can be referred to as *consequential* research since its focus would be on the consequences of the working rules upon the transactors. Economic research that focuses on the segment B-A can be referred to as *compositional* research since its focus would be on the ways in which political capital—the seemingly ultimate dividend of economic power in capitalist societies—is used to influence the working rules.

Seagraves offers an example of Virginia apple growers compelling the destruction of contiguous red-cedar trees. He also talks of cities levying surcharges on the pounds of industrial waste treated. The first institutional change he casually attributes to "new knowledge" and possible "low cost and simplicity," not stopping to explore the Samuels position regarding the economic (and political) power of the apple growers [7, 8]. Likewise, where the surcharge has been employed, its "cause" is immediately attributed to "high costs of waste treatment and extra heavy industrial waste loads." Yet, let us look at other causes of these institutional changes.

The particular institutional change in Virginia—a redefinition of property rights—cannot merely be attributed to new knowledge. There were a multitude of contributing factors—not the least of which was the incipient political power of the apple growers. In the surcharge case, high waste treatment costs are not sufficient causal factors, since it is likely that other cities with equally high costs have not adopted the surcharge. No, the answer lies elsewhere—that is, in the forces that were brought to bear to adjust the working rules. In both of the above instances, *compositional* research would be directed at revealing the real causal factors for the new institutions. Neo-

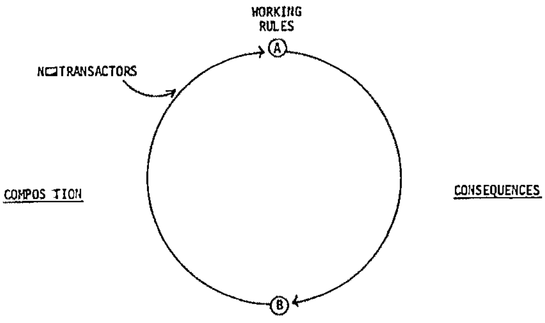

Figure 1

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[2] Schmid more recently defined institutions as ". . . ordered relationships among people which define their rights, exposures to the rights of others, privileges, and responsibilities" [9, p. 893].

classical economics, while contributing several candidates, will miss the mark badly in isolation from other important factors. Why did city A's authority adopt surcharges while city B's did not? How do the authorities differ? How are they similar? Seagraves asks us to ". . . evaluate solutions that have been tried in other regions," yet this evaluation must be careful to avoid the omission of key variables.

While on the subject of forces on the nature of working rules, Seagraves (apparently approvingly) cites correspondence with Robert Dorfman to the effect that the concentrated interests of polluters often dominate the diffuse interests of pollution "resisters." He goes on to cite Crocker's [4] concern that the initial endowment of property rights can influence the incidence of transactions costs. Yet, several paragraphs later he asserts, "Economists can also discount the idea that it is necessary to know who counts, or 'who is imposing upon whom,' or who has the property rights before one can usefully make efficient analyses of these troublesome joint-products [11, p. 619]." What does "efficient" mean in this situation?[3] This curious inconsistency is exceeded only by the next phrase that institutional economists are mainly concerned with whether or not the efficiency gains "can support a newly defined right." Quite the contrary—institutional economists are concerned with "whose ox is being gored," the role that alternative institutions (working rules) play in determining the nature and extent of the "goring," the reasons why (group) A's "ox is gored" while (group) B's is not, and the obstacles to institutional change which mean that (group) B remains in the favored position. "Efficiency gains" are a concern, but hardly the primary one. Going back to Figure 1, the first two concerns are with the consequential side, while the latter two relate to the compositional side.

Yet traditional disdain for the incidence of transactions costs—to say nothing of the incidence of benefits and costs of institutional reform—results in little attention being paid to the compositional segment of Figure 1. That is, this form of economic research would concentrate upon explaining or rationalizing current institutions (working rules, including prevailing prices) as the logical results of certain economic and political conditions. Turning to consequential research, the concern becomes that of explaining current action in light of existing institutions (working rules) and predicting future action under different institutions. The Coase literature is in this vein, as is all of the work on bribes and charges. Indeed, much of traditional natural resource economics is of this nature. And, no small amount of research has been conducted on the actual level of working rules (prices)—not as a derivative of power as in the compositional area, but as the "natural" resultant of a set of unexplored, unquestioned, and perhaps unappreciated institutional factors assumed away in the analysis.

Conclusions

Seagraves argues that a better understanding of the causal factors in environmental problems can only come from an improved consideration of alternative solutions; with that there can be no disagreement. But, he goes on to say that we should look at solutions that have been tried and found "successful" elsewhere. That is the rub. For, whom do we consult for the definition of success? The Virginia apple growers? The railroads? The ranchers? Me? My neighbor? The concept of "success" is an empty box —to be determined by Commons' "law-givers and law interpreters." What is "successful" about the reduction in dumping in one jurisdiction is that it fits our expectation of human behavior in response to increased dumping costs, and it makes the river cleaner. But each instance of success must be linked to a clearly defined social goal—a collective value judgment. *One cannot make decisions about optimal institutions without making prior value judgments about collective goals.*

In this vein Seagraves has introduced the unfortunate distinction between "positive" and "normative." It is unfortunate since it implies that there is a value-free (non-normative) economics. When Seagraves' Positive Economist (PE) declares that tax level X *will* correctly internalize the externalities, there is an ostensible difference from when his Normative Economist (NE) declares that tax level X *should* be instituted. While the difference is apparent to all students of economics, it is indeed more apparent than real. The reason is, of course, that current distributions of wealth underlie current relative prices which form the basis for PE's tax "finding of fact." While traditionalists will argue that PE was nonetheless not interjecting his *personal* wishes, as was NE, his implicit acceptance of current relative prices is, *de facto,* value laden. Thus, the conventional distinction between positive and normative economics is excess intellectual baggage that serves little useful scientific function. Indeed, it probably gives rise to a false sense of objectivity about a social science that is derived from our efforts to lend structure and order to otherwise chaotic pecuniary intercourse.

The Seagraves advice to look elsewhere also suffers if our conceptual model of institutions and institutional change is weak or incorrect. This can result in at least two kinds of logical mistakes. First, empirical observations will result in misleading policy recommendations if our explanatory model is incomplete; bias from omitted variables is not confined to regression models. Second, such empiricism lends an aura of science to conclusions that are inherently value laden. The following assertion must be examined: "If there is no way to increase the size of the pie by creating a new environmental institution, then the redistributional effects would have to be *very dramatic* to merit study [italics mine]" [11, p. 619]. What is *very* dramatic? Whose conclusion is this? Economic theory's? Seagraves'? This seems like a curious way to "appraise environmental institutions."

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[3] "Efficiency" and "effective" are used several times with unclear connotations. For instance, on page 619 Seagraves asserts that "one should not expect environmental programs to be effective ways to help the poor." Yet, if the poor live in blighted parts of our cities (which they do), if the poor swim in polluted rivers (which they do), if the poor do not live in the green suburbs where clean air is available (which they do not), then what sense does it make to say environmental programs are not *effective* ways to help the poor? Can we be so sure that this is true?

But the singular weakness of the Seagraves paper is its failure to offer economists a meaningful conceptual framework for understanding institutions, institutional change, and institutional economics. Economists will be understandably confused to be told that institutions consist of money, working rules, private companies, private and public programs, and public organizations. The confusion is compounded if institutional change is analyzed in the context of supply and demand analysis, and rates of return. This confusion will result in the continued avoidance of many important economic problems, or, perhaps worse, spawn research which starts from an incorrect problem definition—and consequently contributes little to the appraisal of environmental institutions. Unless institutions are clearly understood, and unless the compositional and consequential aspects are fully appreciated, the appraisal of environmental institutions is doomed to fail. That is a luxury we can ill afford.

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ON APPRAISING ENVIRONMENTAL INSTITUTIONS: COMMENT*

There is much that is disturbing to me in Professor J. A. Seagraves' recent article [10]. In this Comment, several of his major arguments have been selected for discussion; space is not available for comment on all of our areas of disagreement.[1]

Rights and Efficiency

Before going any further, it is necessary to establish firmly the relationship between the structure of rights, economic efficiency, resource allocation, and the distribution of income, wealth, and power. In the process it is appropriate to make some observations with respect to the Coase theorem [3], since Seagraves draws upon the Coasian literature to develop his case for the primacy of efficiency considerations in economic analyses of institutional structures.

If there is an identifiable Coase theorem, it is usually expressed as follows: "under perfect competition, the assignment of liability is allocatively neutral."[2] Some have broadened this statement still further by substituting "rights" for "liability."[3] Assume for a moment that this theorem is valid and applicable, without circumscription, to the real world. Then its import would be as follows: since allocation is unmodified by the assignment of rights (given rights consistent with perfect competition), *the empirical, analytical study of rights can be confined to the study of distributional matters.*[4]

Fortunately for Seagraves (since such a conclusion would be distressing to him), the Coase theorem is not valid and applicable, without circumscription, to the real world. Nor is the necessary circumscription insignificant. The Coase theorem ought not be articulated, as it sometimes is, with the proviso "*ceteris paribus* transactions costs and income effects," so as to imply that the proviso is really negligible. Rather, the proviso is sufficiently important to dominate the theorem totally. In reality changes in rights will have allocative and distributive impacts of substance [6, 8, 9].

The import of the Coasian literature is not that any structure of rights consistent with efficiency will yield the efficient solution, but rather that different structures of rights throughout the socioeconomic system yield solutions that are empirically different in every respect. For each different structure of rights, the efficient solution will differ in respect to allocation, distribution, relative prices, and the whole range of macroeconomic variables. Efficiency is nonunique. This fundamental proposition will provide a basis for discussion of several important issues: the value of the positive-normative dichotomy, the conceptual feasibility and practical wisdom of separating allocative and distributive considerations, and the appropriate direction for economic research on institutional structures.

The Positive-Normative Dichotomy

In describing efforts to generate and disseminate knowledge, the terms "positive" and "normative" seem somewhat unhelpful. Perhaps there is no truly positive analysis. Nowhere is the inadequacy of the concept of positivism more obvious than in the study of the structure of rights.

In the sense that "positive" and "objective" are used as adjectives to describe research which is concerned with determining "what is" and is performed in a manner which is neutral, disinterested, and independent of value systems, these terms are almost meaningless in the context of the empirical study of institutional structures to generate efficient allocation of resources. The economic methodology which has been associated with the terms positive and objective involves the use of prices and other economic information generated by one system of rights to evaluate the efficiency of a change to an alternative system of rights. This kind of analysis can only ask one question: does the "new" set of rights generate a greater value of output *when measured according to rules created by the "old" set?* Such a methodology is in no way neutral, disinterested, and independent of value systems. Rather, it introduces an inexorable bias in favor of the status quo and systems of rights which would strengthen and reinforce the status quo. The legitimacy of the status quo is implied by such a methodology [8]. Seagraves, among others, applies the terms positive and objective to analytical methodologies which are in fact strongly biased in a conservative direction.[5]

Due to considerations such as these, there is a genuine doubt about the value of the positive-normative dichotomy. Perhaps a more useful dichotomy

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[1] In particular, I shall leave it for others (e.g. Bromley [1]) to comment on Seagraves' inadequate understanding of the nature of institutions and the engines of institutional change. The "induced institutional innovations" hypothesis is a particularly unsatisfying concept, since it suggests only that changing conditions generate a demand for institutional change, but is of little help in predicting the kinds of change which will occur; and in the hands of Seagraves, among others, overemphasizes the role of price as the "inducer" of institutional change.

[2] See [6] for a much more complete articulation.

[3] See [8] for some comments on the validity of this practice.

[4] Where the rights structure is not consistent with efficiency, deductive logic is all that is required to define a set of rights which is.

[5] Throughout, the term "conservative" is used literally: "tending to support preservation of the status quo."

would be *analytical* vs. *polemical*. In the analytical set would fall all research which has traditionally been called positive and conditionally normative, and also a goodly subset of that which has been called normative. The polemical set would include efforts such as promotion, pamphleteering, lobbying, and advertising, which are concerned with making a case for particular value systems and particular solutions to problems. The analytical set would be distinguished from the polemical as follows. The analyst would be ethically obliged to use the best techniques and the most complete information which can be obtained in his research and to report all relevant information resulting from his efforts. He would avoid impact distortion [7]. The analyst would make public any value premises which are crucial to his analysis and the interpretation of his results, so that the reader may better evaluate his findings and recommendations. On the other hand, the polemicist is under no such obligations; he may freely emphasize that information which supports his particular brief.

Given this dichotomy, Seagraves and I would join together (I am sure) in calling for more and better *analytical* research on environmental institutions and, more generally, the structure of rights.

Separation of Allocative and Distributive Considerations

One is constantly amazed at the arrogance of economists who attempt to narrowly define economics and economists in such a way as to include themselves and their efforts but exclude the legitimate efforts of others. Seagraves [10, p. 619] presents an example: ". . . the institutional economist is mainly concerned with whether or not the efficiency gains can support a newly defined right." The fact that Seagraves is not alone in this kind of arrogance[6] does not absolve him of blame.

Surely the profession of economics is sufficiently broad to recognize that the issues of output and distribution of that output are both of great importance.[7] For evaluation of alternative structures of rights, efficiency is a totally inadequate criterion: efficiency is non-unique when rights are variable, and thus the separation of allocative and distributive considerations is conceptually infeasible; and efficiency is not all that is important. The task of the analytical institutional economist is to develop methodology for the simultaneous analysis of allocative and distributive considerations.

Conservative Biases

The fundamental, conservative bias inherent in "positive" efficiency analyses which use the information derived from an economic system based on one set of rights to evaluate an alternative set of rights has been emphasized above. To this methodological bias in favor of the status quo, Seagraves adds two additional personal, conservative biases. First, ". . . redistributional effects would have to be very dramatic to merit study" [10, p. 619]. This from an economist of the marginalist school! The suggestion that marginal increases in output are worthy of intensive study while changes in distribution which are less than "very dramatic" are not must be recognized as not only a value judgment but a strongly conservative value judgment which, when made explicit, is unlikely to garner the support of a majority of economists. Second, Seagraves enunciates a clear preference that redistribution of rights ought to be minimized [10, p. 620]. This, again, implicitly accepts the legitimacy of the status quo distribution of rights.

Perhaps this is the place to consider Seagraves' proposition that the "property rights approach" is a more objective approach to institutional analysis. Seagraves has made his case the more difficult by articulating a consistent, conservative bias in his article. Yet Seagraves is not unusual for a member of the so-called property rights school. Samuels [8] has revealed the conservative bias inherent in the "presumptive efficiency" reasoning which characterizes much of the writings of the property rights school. In an interesting recent manuscript, Goldberg [4] exposes to scrutiny a number of explicit and implicit conservative biases which permeate the work of what he has called the Buchanan wing of the property rights school. There is much of value for analytical purposes in the work of the property rights school, but a disinterested objectivity is not one of its stronger points.

A Better Way

Thus far I have delivered only a critique of the thrust of Seagraves' neo-Austrian manifesto for institutional economics. Yet in my critique there are implicit some suggestions for an alternative approach to the study of institutions. An analytical approach to this study needs to be directed toward at least the following:

1. The study of the outcomes in terms of output, and distribution of income, wealth, and human and civil rights of alternative structures of property rights. The economist who recoils at the notion of "playing god" (e.g., Tollison [11, p. 4]), ought not find offensive the notion of providing a full spectrum of information and allowing the people to arrive at

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[6] Other examples from the recent literature are these: "When non-individualistic norms are introduced, the domain of economics, as I define the discipline, is abandoned" [Buchanan, 2, p. 188]; and "Like Robin Hood and his merry men, the economist believes in taking from the rich to give to the poor" [Mishan, 5, p. 971].

[7] It is, perhaps, important to point out that the structure of rights and institutions has implications for distribution at both the micro and the aggregate levels. An institutional change which falls far short of making the poor, in aggregate, rich may have substantial distributional impact at the micro level. Distributional impacts at both the micro and aggregate levels are worthy of analysis.

social decisions. Maybe there is more than a little of "playing god" inherent in a research philosophy which maintains a conspiracy of silence on all but allocative issues!

2. The study of the process of institutional choice. Since institutional choice is a partial function of the distribution of power, publication of information about the process of choice may enable the people to confront the issues of both choice and power more effectively.

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ON APPRAISING ENVIRONMENTAL INSTITUTIONS: REPLY

First, my critics and I disagree as to the relative importance of studying the allocative or the distributive effects of new environmental institutions. By way of granting them a bit of ground let me cite a comment that Emery Castle offered in personal correspondence on the Gainesville version of my paper: "You are correct, I believe, in separating, for some purposes questions of resource allocation and the distribution of wealth. Which questions an economist wishes to tackle first, however, seems to me incapable of a general a priori answer. It must depend on acuteness of social problems, abilities of the researchers, and possibly other factors."

Careful definition of an applied problem includes specifying what decision is involved, who will be making it, and how the research results will be used by the decision makers. If a research worker first defines his problem well and then becomes well acquainted with alternative solutions that have been tried plus those presented in the literature, he will then have an idea as to which systems he should study, and which effects of new institutions should receive most emphasis. How does Castle's "acuteness of social problem" relate to my "definition of the problem"? They are the same. "Acuteness" helps define the time that will be allowed for the study, and the word "social" indicates the relative importance of considering distributional alternatives. Definition of the problems is much more important in the selection of alternatives to be considered and methods to be used than the "abilities of the researchers." If the problem is defined well and the literature properly reviewed, incompetent researchers will automatically withdraw from the competition.

Environmental issues are inherently resources allocative. A mixture of rich and poor rascals are doing something stupid with the world we love. Defining a new dimension of life (monetizing a new right or an obligation) may be the best solution. What do we gain? Not cash in the public till, nor a sizable transfer to the poor. We gain a cleaner environment which we think will be closer to some special optimum.

Second, *an analysis of the process of institutional change* is a very different thing from the topic of my 1972 paper, *the appraisal of new environmental institutions.* The latter could easily include appraisal of some alternatives that solve the problem of resource allocation very well, but which are not at all feasible politically. The former includes an analysis of lobbying, lying, and optimum expenditures by different groups who are working to change an institution. This is an exciting new field within political economy. But, to the extent that my critics are accusing me of not addressing the whole process of institutional change, they are simply unfair. That was not my purpose.

Professor Randall could strengthen his case by giving some examples of environmental issues that are highly charged with income transfers. It should be noted that he hardly mentions "the environment" after his first page. Contained in the first paragraph of the section "A Better Way," his prescription that all the effects of a new property right should be studied might be appropriate if one were evaluating something as loaded as the abandonment of progressive income taxes, but it hardly applies to a study of emissions taxes. Most conservative economists recoil at the notion of "playing god" and find especially offensive an approach to research in which one promises to "provide the full spectrum of information" about anything. Research, and especially the definition of the problem and the formulation of hypotheses and methods, always involves a lot of decisions about what not to study. It is inherently selective. That is what my paper was about. I want to use this opportunity to remind my critics that the papers of Ronald Coase and Steven Cheung are also useful in making these tough decisions about what things to study.

Bromley should re-read my paragraph on Samuels:

> New knowledge *may* have been partly responsible for the timing of this 1914 law, but Samuels describes it as a case of the economic power of the apple growers leading to the law and its successful defense through the courts. It is also *possible* that condemnation seemed like a less costly and simpler institutional procedure than having a group of orchardists buy easements from the owners of the cedar trees. [italics added here]

Bromley has warped my statement into a charge that I "casually attributed" this change to " 'New knowledge' and possible 'low cost and simplicity.' " He not only misunderstood, but also misquoted me.

Bromley also discovers a "circularity" in my summary of the Davis and North position; I think the idea that institutional change depends on the institutional base from which one starts is obvious. If Bromley thinks that it is so important, so "true, . . . confusing and must be analyzed," then why does he not analyze it? Since institutions are endogeneous, outdated institutions are simply one class of economic disequilibria. Disequilibria that are both important and persistent almost always show up as demands for institutional change (political action). The potential for the gainers to bribe the losers must be a more important *engine* of change than the power of the losers to hold onto what they have. These ideas are simply too obvious to merit elaboration.

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FARM COMMODITY PRICE STABILIZATION THROUGH FUTURES MARKETS: COMMENT*

In their recent paper "Farm Commodity Price Stabilization Through Futures Markets" [7], Richardson and Farris report the results of a simulation of an illustrative price stabilization formula suggested by Houthakker [4]; they conclude that implementation of the scheme via the futures market would have been de-stabilizing. This conclusion is then followed by some speculation on the effect of attempting to stabilize prices via the futures market.

It is not the intention of this paper to "defend" the exact wording used by Houthakker six years ago, nor to attempt to quibble with the exact details of the methodology used by Richardson and Farris, but rather to point out that Richardson and Farris have taught us something about a stabilization formula and nothing about its method of implementation. This does not detract in any way from the value of their research, but since *this Journal's* referees seem to have thought they had a paper contributing to our understanding of the use of the futures market for stabilization purpose, the distinction seems worth making.

To review briefly the findings of Richardson and Farris, they found that with an Indicator Price (= 3 year annual moving average of prices)[1] the initial stocks necessary to have available to release onto the market, and maximum stocks which would have to be held off the market were [7, Table 1]:

Soybeans	*IP* ± 20 percent		*IP* ± 15 percent	
Stocks (M. bu.)	$\eta = -1$	$\eta = -.5$	$\eta = -1$	$\eta = -.5$
Initial	30.99	15.49	7.51	3.76
Maximum	39.42	19.72	153.76	76.90

where

IP ± 20 percent indicates a ceiling of Indicator Price + 20 percent, and a floor of Indicator Price − 20 percent,

and

$\eta = -1$ indicates a demand elasticity of -1.

These stocks would have had to be available—and held off the market—for the stabilization formula examined by Richardson and Farris to have been effective, using their assumptions, *regardless of whether the stocks were held by private trade or the Government.* Their analysis of this pricing formula[2] has nothing to say about how many (5000 lb.) futures contracts would in fact have to be sold to hold 5000 lbs. of soybeans off the spot market. They *assume* a 1 to 1 relationship between sale of futures contracts and beans held off the spot market. It seems highly implausible that either there would be *no* speculative positions induced on either side, or that induced speculation would exactly balance.

What their analysis does tell us is that a three year moving average with ± 15 to 20 percent floor and ceiling is not highly stabilizing for soybeans but would require large stocks (whether in a government buffer stock, or private hands) to be enforced.

This suggests a search for more effective stabilization formulas such as longer period moving averages, closer ceiling/floor bounds, and/or formulas which reduce only the extreme fluctuations. Alternative formulas for liquidating positions taken to stabilize prices also need to be examined. Some of these formulas have already been examined in the Australian floor price literature [1, 2, 3, 5, 6]. We also need to know how much money the stabilization authority would have required, whether it would have made a "profit" and the distribution of gains between producers and consumers.

It is tempting to argue item by item with the speculative section of [7], but perhaps it is sufficient to point out that the verdict on a futures-based stabilization scheme is still, as the Scottish say, "not proven."

For instance: How much money would the Government have had to put in to enforce an $8 ceiling on soybean futures prices?[3] And would this have been a good thing?

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* The research reported in this paper was conducted under Indiana Experiment Station Project 1595. The views expressed, however, are the author's responsibility.

[1] It would perhaps have been more interesting to calculate *monthly* indicator prices so that January's Indicator Price would have been the average of the January prices for the previous three years.

[2] It is not clear from [7] that Houthakker's exact proposal was followed (i.e., roll forward contract when price is within 5 percent of floor, buy fixed amount when price is within 5 percent of floor, liquidate holdings at the Indicator Price, allow stock accumulations of six to nine months previous to be released to the market when the price is below Indicator Price, but above 5 percent of the floor, and so on), nor is it important.

[3] Houthakker explicitly warns against entering into a squeeze situation. Possibly exchange rules should be modified to give a default gain (say $2 per bushel), in which case squeezable stabilization could be initiated—"stabilization without stocks."

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FARM COMMODITY PRICE STABILIZATION THROUGH FUTURES MARKETS: REPLY

Professor Candler's suggested need for research on more effective price stabilization formulas is a worthy objective, although not that of our paper. Our main purpose in the paper was to examine the logic and basic workability of a particular price stabilization scheme, recently advanced by H. S. Houthakker.

In examining Houthakker's proposal it became necessary to identify and consider the underlying premises which appeared to be involved. An example was set up which incorporated Houthakker's assumptions, along with operating rules believed to be favorable to the proposal. We encountered difficulties which led us to question the proposal's feasibility. Moreover, even if the proposal could have been made operational, possibly by considering variations in assumptions and rules, the government would likely have been drawn into a commodity storage program. This was an outcome which Houthakker had sought to avoid.

One difficulty in Houthakker's proposed government intervention in futures markets arises from close relation among the intertemporal constellation of prices. For example, bidding up the price of a commodity in a particular futures contract month creates a profit incentive for all other temporally related prices to be bid back in line. The tendency would neutralize the effects of government futures trading on stock redistribution through time.

Several other problems exist in practical application of Houthakker's proposal. Among these are unknown effects of market intervention by the government on market participants, commodity utilization patterns, and supply response, both in the short and long run.

Although not important to the issues, an inconsistency appears in Professor Candler's table. He shows initial stocks for *IP* ± 20 percent to be 30.99 and 15.49 million bushels for elasticities of -1 and $-.5$ respectively, apparently arrived at by computing the difference between stock accumulations and depletions during the period under each elasticity assumption. But for *IP* ± 15 percent, his entries are the first year amounts. Also, at another place, futures contracts are indicated in pounds instead of bushels.

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ECONOMIC ASPECTS OF GROUND WATER RESOURCES AND REPLACEMENT FLOWS IN SEMIARID AGRICULTURAL AREAS: COMMENT

In a recent issue of this *Journal,* M. Gisser and A. Mercado [3] propose a steady-state model for determining optimum pumping levels and replacement flows for a single-cell aquifer. A major contribution intended for this paper is that of providing ". . . a theoretical integration of *economic* and *hydrologic* analysis of replacement flows" [3, p. 461]. The purpose of this Comment is to offer three suggestions which should substantially increase the palatability and operational appeal of Gisser and Mercado's results.

First, there seems to be some confusion as to the dynamic relationship between the height of water tables and (artificial) replacement flows. H is the depth of the water table, H_m is a "minimum allowable level" for water tables below which the aquifer suffers "unacceptable" damages [3, p. 463], and H_s is the water table under steady-state conditions. Gisser and Mercado argue that if H_s (in some undefined dynamic sense) is reached before H_m, there is no need to consider replacement flows; if H_m is reached before H_s, replacement flows should be considered.

Except in the case where H_m is simply the bottom of the aquifer, we would argue that H_m and H_s are the same. In any dynamic economic analysis (see, e.g., Burt [1] or Cummings [2]), groundwater is pumped at a periodic rate such that current marginal benefits (*CMB*) from pumping equal the marginal value of water in storage (*MVWS*). The *MVWS* includes such measures as increased pumping costs, increased saltwater intrusion (Cummings [2]), and all other "damaging" effects which result from an increment in current pumping. So long as $CMB \geqslant MVWS$ at a positive level of mining, overdrafts on the aquifer continue (in Gisser and Mercado's terminology, H is still at "acceptable" levels). At that point H^* where $CMB < MVWS$ for all levels of mining (water-use in excess of natural recharge), future mining is non-optimal (i.e., costs of mining are "unacceptable"), steady-state H_s obtains, and $H^* = H_s = H_m$ satisfies Gisser and Mercado's definition of H_m. Again, there is no conceptual difference between H_m and H_s; "unacceptability" simply means that the costs of mining, as measured by the *MVWS*, exceed benefits (*CMB*).

Of course, the use of replacement flows depends on the relationship between the cost of replacement water and the *MVWS*. If such costs are *less* than the *MVWS,* replacement flows are used. Replacement flows may be used before *or* at the point where $H_s = H_m$ obtains.

Second, there seems to be some confusion in Gisser and Mercado's optimization processes regarding replacement flows [3, pp. 464 and 465]. The set of equations (7.1), (15), (16), (6.1), and (3.1) are used to solve for W, R_a, P_3, P_2, and P_1. Given these values, along with the production and profit functions (19) and (20), profits may be *determined* if A (other inputs) is known. But Gisser and Mercado wish to maximize profits with W (water, which is assumed fixed) as a variable input [3, p. 464]. This inconsistency is made manifest by noting, in the discussion following equation (19), that W is treated as a variable while P_3, *which is a function of* W [see equation (16), p. 464], is treated as a parameter determined by the solution of (7.1) – (3.1).

For consistency, Gisser and Mercado may solve (7.1) – (3.1) on p. 464 for W, R_a, P_3, P_2, and P_1, and use (19) and (20) to solve for A. This adjustment may detract from the richness of results which they seek, however.

The third point which we wish to raise concerns Gisser and Mercado's P_2, the cost per unit of replacement water used for artificial recharge (R_a), which *includes* the cost of shipping (transferring) the water from distant basins [3, pp. 464–465]. Suppose (as do Gisser and Mercado by implication) that the transfer system is already built; we thus abstract from the multifarious problems associated with the determination of an optimal scale for a system which is characterized by economies of scale (see Regev and Schwartz [4]). With the transfer system fixed, the cost of the transfer system is fixed as is the annual charge. To recover this fixed cost, P_2 must be a *decreasing* function of replacement waters R_a; i.e., Z_1 in Gisser and Mercado's equation (15) is negative in sign. Note particularly that Gisser and Mercado's equation (24) becomes $P_3 = P_1 + \frac{Z_0 R_a}{W} + \frac{Z_1 R_a^2}{W}$. With Z_1 negative, the tax recommended by Gisser and Mercado [3, p. 465] may in fact be a *subsidy.*

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ECONOMIC ASPECTS OF GROUND WATER RESOURCES AND REPLACEMENT FLOWS IN SEMIARID AGRICULTURAL AREAS: REPLY

We consider the three suggestions by Cummings and McFarland in the same order as they are presented:

(1) We do not accept the notion that "except in the case where H_m is simply the bottom of the aquifer, . . . H_m and H_s are the same." For example, the water table may drop below a certain level, thus leading to the infiltration of saline water from an adjacent aquifer. Since this is almost an irreversible process, the damage is unacceptable. Another example could be the combination of a river and a basin. Reversing the flow relationship between the river and the aquifer may be illegal. Such examples, where H_m is known as the "Red line," are rather common in semiarid regions such as Israel and New Mexico.

(2) There is no confusion in our optimization process. It seems that Cummings and McFarland failed to notice that in principle equation (6.1) is the same as equation (21). In fact, equation (6.1) is (21) linearized for technical purposes. Thus, given the set of equations (7.1), (15), (16), (6.1) [or alternatively (21)], (3.1), (22), and (19) plus the level of H_s, we can determine P_1, P_2, P_3, P_a, W, Q, and A. Then, utilizing equation (20), we can determine the maximum profit (per H_s). Then by equation (23) we determine the optimal level of H_s.

(3) The cost per unit of artificial water is definitely positive: $P_2 = Z_0 + Z_1 R_a$. We admit that a more realistic form would be $P_2 = \frac{Z}{R_a} + Z_2$, where Z is a certain fixed cost and Z_2 is the cost of transferring one acre-foot and recharging it. But, even such a form does not make P_2 negative!

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ESTIMATING EDUCATIONAL PRODUCTION FUNCTIONS FOR RURAL HIGH SCHOOLS: COMMENT*

Bieker and Anschel attempted to give an empirical answer to the question of ". . . whether production relationships differ significantly between curricula within rural high schools when a single standardized achievement test is used to measure achievement in all curricula [1, p. 515]." It is doubtful that many people familiar with psychological or educational testing would think that a single standardized achievement test which measures basic academic achievement through scores on English, numerical competence, mathematics, reading, science, and spelling could also function as a valid measure of achievement in a vocational or general curriculum. If the Stanford Achievement Test could validly measure achievement from these curriculum areas, then we would not have to produce separate achievement tests for business education, industrial arts, and other areas more closely related to the general and vocational curriculum. Exhaustive research at the Research and Information Center of the North Carolina State Department of Public Instruction [B. Dail, personal communication, February 4, 1974] revealed no investigations which used a single standardized achievement test as a measure of achievement for different curricula. One can either interpret this as meaning that it was time that a study such as this was done to provide empirical evidence concerning these relationships, or that it was a rather ridiculous endeavor given our knowledge of what standardized achievement tests are measuring. Though the latter interpretation is preferred by the author, the former must not be totally rejected due to the lack of data on the subject. However, even if the objective of the study is accepted as worthy of an investigation, certain problems remain.

Bieker and Anschel hypothesized a model which stated ". . . that the educational achievement of an individual student during a specified educative period depends upon the level of resources invested in the student by the school system, the student's innate ability, and the extent to which the student's family supports and compliments the formal educative process" [1, p. 515]. This statement could be modified by addition or subtraction of variables hypothetically involved in the educative process depending on personal bias and/or interpretation of the data concerning achievement resulting from the educative process. Generally speaking, this statement does not present many problems. This model is then presented as a function, $A = f(X_1, X_2, X_3, X_4, X_5, X_6,)$, and the components are operationally defined. It is at this point that specific problems arise which have bearing on the validity of the study.

A represents student achievement as measured by the Stanford Achievement Test. However, no mention is made of when the tests were given. We do not know whether everyone took the test the same year or different years, something which could seriously affect the results of the study. The educative period for the students is mentioned, and one can only assume that the testing took place at the beginning and end of this period.

Additionally, their variable X_4 represents student mental ability as measured by the Otis-Lennon Mental Ability Test. In the original model this factor was called student's innate ability, a more general term, which could include abilities other than mental which might have different relationships to an achievement measure. It is not stated when the mental ability tests were administered. If the mental ability tests were not administered at approximately the same time as the achievement tests, then this introduces additional error variance which could significantly affect the results. Indeed, it is possible that such omission could have confounded the results sufficiently to produce the statistical insignificance discussed on page 518 of their report.

Another aspect of this situation which could have affected the regression coefficients is the range of mental ability of the students. It is possible that the lack of relationships between the mental ability and achievement scores for the academic group could be due to lack of variation in the mental ability scores. This would particularly be the case if there is a systematic tendency for students with lower mental ability scores to end up in vocational curricula, as might be expected.

X_5 is a scaled measure of student motivation which was based on a battery of five questions. The Guttman procedure was then used to produce a unidimensional eight-point scale. No support is presented to indicate that the battery is valid. Nevertheless, proceeding under the assumption that the battery is valid, there are problems involved in the use of the Guttman Scale. Nunnally states, ". . . the deterministic model underlying the Guttman Scale is thoroughly illogical for most psychological measurement because (1) no items exist that fit the model, (2) the presence of a triangular pattern is a necessary but not sufficient condition for the fit of the model in particular instances, (3) the triangular pattern can be (and usually is) artificially forced by dealing with a small number of items that vary greatly in difficulty, (4) the model aspires to develop only ordinal scales, and (5) there are better intuitive bases for developing models for psychological attributes. Considering this heavy weight of criticism, it is surprising that some people still consider this deterministic model a good basis for developing measures of psychological attributes" [5, p. 186]. Even if one dismisses these, Guttman [3, 4] has indicated that samples of a dozen items from the universe are needed to test the hypothesis of scalability. Measures of affect are traditionally so weak in terms of validity that the lack of information concerning this motivation scale becomes rather critical.

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* Thanks are extended to W. A. Ward for helpful suggestions.

The final aspect of the model is stated as ". . . the extent to which the student's family supports and compliments the formal educative process" [1, p. 515]. This is represented in the function by X_6 parent's average grade attainment. No attempt was made to rationalize why average grade attainment was used as a proxy for family support and compliment of the formal educative process. Since the Coleman Report [2] found the only characteristic that showed a consistent relationship to academic performance was the social class of the student body, perhaps a more comprehensive socioeconomic measure would have been a more appropriate proxy. It seems the result of Bieker and Anschel's test on this variable is more subject to specification error than to a lack of actual causation.

The Bieker and Anschel [1] article basically set out to deal with the hypothesis that there is no unique function to describe the relationship between high school inputs and product. That very few, if any, scholars see this as a significant topic is illustrated by the lack of research concerning the subject. It is suggested that, rather than being a revelation of some import which had been heinously overlooked in the past, no one capable of doing research in the area would believe that a standardized measure of academic achievement could validly measure the achievement of students in a vocational or general curriculum. Even if this obstacle was somehow rationalized to unimportance, many problems still remain. In essence, if Bieker and Anschel were convinced this study was worth doing, then one wonders why they did not do a better job.

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ESTIMATING EDUCATIONAL PRODUCTION FUNCTIONS FOR RURAL HIGH SCHOOLS: REPLY*

Professor Bradley's critique of our communication [2] causes us to suspect that he has misread it. He seems to think we are criticizing educators and psychologists for using standardized achievement test results to evaluate schools or individual curricula. Rather we are critical of social scientists searching out the relationship between educational inputs and products who use achievement test scores as a measure of educational product. Others have criticized this method for ignoring education's multiple products. Our point is somewhat different, *viz.*, that the structure of the relationship between inputs and outputs differs between curricula. Even if achievement were an adequate measure of product, we show that the structure of relationships is different for each curriculum. Hence studies deriving educational production functions for schools or school districts which contain more than one curriculum may produce misleading results.

Professor Bradley criticizes us for studying a moot issue. He writes, "Exhaustive research at the Research and Information Center of . . . North Carolina . . . revealed *no* investigations which used a single standardized achievement test as a measure of achievement for different curricula [italics ours]." He then suggests that ours may have been a "ridiculous endeavor." Possibly because he is a psychologist rather than an economist or sociologist he is not familiar with the rather extensive literature of such studies. Indeed, as Cohn notes in his review of input-output studies, ". . . achievement scores have been used as the single output in the majority of cases" [7, p. 240]. To familiarize himself with the issue, we suggest that Professor Bradley read or reread the Coleman Report [5], Cohn [6], Kiesling [11, 12], Astin [1], Bowles [3, 4], Raymond [14], Hanushek [8], and Levin [13] among others.

Moreover, our work is not moot for a second reason. The widely accepted notion that the amount of economic resources devoted to education does not affect achievement is largely based on studies which ignored the existence of different curricula in schools [9]. If in fact there are differences in the structure of educational production functions of different curricula, then some doubt is cast on the conclusions of these studies. Policies based on studies which ignore curricula may very well lead to a deterioration of the quality of education.

Professor Bradley also criticizes our analytical techniques. First, he points out that we did not mention the dates on which the students took the achievement tests. As Bradley notes, however, we did specify the educative period (school years 1967–68 and 1968–69). Moreover, we defined the dependent variable as the change in achievement test scores during the educative period. How else then could we have obtained our data but to administer achievement tests at the beginning and end of the period?

Professor Bradley also expresses concern as to when we administered the mental ability test, fearing it may not have been administered at the same time as the achievement tests. Although the most appropriate time is a point of some controversy [5], the Otis-Lennon Mental Ability Test was administered at the time of the second achievement test, i.e., at the end of the educative period.

As a third criticism of our analysis, Bradley suggests that the statistical insignificance of the ability variable in the equations for the academic curriculum is due to the lack of variation in this variable for the academic curriculum relative to its variation in the other two curricula rather than for the reasons we proposed. The coefficients of variation for the academic, general, and vocational curricula are 13.01, 12.90, and 12.54, respectively.

Bradley's fourth point is that he disagrees with the use of parents' average educational grade attainment as a proxy for the extent to which parents support and complement the formal educative process. Bradley suggests that "Since the Coleman Report . . . found the only characteristic that showed a consistent relationship to academic performance was the social class of the student, perhaps a more comprehensive socioeconomic measure would have been a more appropriate proxy." Both Kahl [10] and Reiss [15] indicate that education along with income and occupation constitute the most important dimensions of social class. Moreover, Coleman *et al.* [5] did not use a single proxy for social background but six separate variables: urbanism, parents' education, structural integrity of the home, size of the family, items in home, and reading material in home. They reported that, ". . . in the sixth grade, the child's report of items in the home, indicating its economic level, has the highest relation to achievement for all minority groups, while parents' education has the highest relation for whites. In later years, parents' education comes to have the highest relation for nearly all groups" [5, p. 302]. Thus the proxy Bradley so vehemently criticizes is precisely the one Coleman *et al.* found to be the best proxy for social background.

Finally, Bradley criticizes our student motivation or academic commitment variable (X_5) on several grounds. First he indicates that the Guttman scale is thoroughly illogical for most psychological measurement. While we are not quite sure what Bradley means by "most psychological measurement," we feel that Guttman scale analysis is appropriate in quantifying variable X_5. Indeed, Guttman indicates that scaleogram analysis is appropriate for many types of problems including "the study of aptitudes involved in fitting people into jobs, the measurement of human intelligence and ability, the study of neurotic behavior and other aspects of personality, the appraisal of social status—in short any problem involving the assigning of numerical values to qualitative observations in an attempt to evolve a single rank ordering" [16, p. 61]. We view variable X_5 as an attitudinal variable, i.e., motivation toward learning or academic commitment, and therefore amenable to Guttman scale analysis.

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* The authors wish to thank Dr. Harry Hall for his suggestions and comments.

In addition Bradley implies that since our scale is based on only five items, it is not internally valid. Scale validity is not determined by the number of items on which it is based, as Bradley seems to think. The principal test for scalability is reproducibility.[1] Our scale passed the reproducibility test with a coefficient of reproducibility of .95. In addition the marginal distributions were not characterized by extreme kinds of dichotomizations, and the errors of reproducibility appeared to be random.

In conclusion, we reaffirm the importance of our research objective, conclusions, and the validity of our methods. If additional knowledge of the determinants of the output of educational systems is to be gained, distinctions must be made between curricula.

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[1] For a discussion of the criteria of scalability, see [16, pp. 60–90].

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Editor's Note: Since Musalem's comment is directed to the original article by Ayer and Schuh and to a comment on that article by Saylor, we invited Saylor as well as Ayer and Schuh to respond.

SOCIAL RATES OF RETURN AND OTHER ASPECTS OF AGRICULTURAL RESEARCH: THE CASE OF COTTON RESEARCH IN SÃO PAULO, BRAZIL: COMMENT*

This paper discusses some important concepts related to the methodology used by Ayer and Schuh [1] to estimate the social rate of return to investment in cotton research in the state of São Paulo. The discussion will be centered on the following points: (a) the structure of the model used; (b) some considerations about their estimate of the shift parameter in supply; (c) the valuation of increased output and additional labor used; and (d) a suggestion to use a simple static model of a traded commodity to estimate the relevant rate of return. In the course of the analysis some remarks on Saylor's [4] comments on the Ayer-Schuh paper will also be made. The present paper will not consider distributional effects of technological change.

Structure of the Model

The model used by Ayer and Schuh is a recursive cobweb partial equilibrium model. Their estimate of social returns, though they do not mention it, is a result of changes in consumer surplus plus changes in cost of adjustment due to technological improvement in cotton production. Figure 1 corresponds to theirs. Social returns equal $(OABC) - (OAD) - (OEFC - OEG)$. Thus, the net increase in consumer surplus equals $(OH'H)$, while the net change in adjustment cost equals $DBH' - GFH$. Social returns, therefore, are $(OH'H) - (DBH' - GFH)$. A shift from S to S' will generate the same results.

Though Ayer and Schuh cited Peterson's [3] paper as the source of their basic methodology, they have not extended his static model to their recursive cobweb model. Peterson's analysis implicitly assumed a general equilibrium model in which a neutral technological change is observed and has a stronger effect on the sector being considered. Under those circumstances, the crucial parameter that affects the factor market is the discrepancy between the price elasticity of demand for the sector and an elasticity of unity (see [2]). If this elasticity is equal to one, the full increase in output due to improvement in factor productivity will be observed by a proportional decline in product price. Therefore, factor rentals will not be affected, and no dislocations of factors will occur. When demand elasticity is greater than one, the fall in product price will be less than proportional to the increase in output due to increases in factor productivity. Therefore, factor rentals will increase, motivating a dislocation of factors toward the progressive sector, further increasing output. The reverse effect occurs when demand elasticity is less than one.

Here, an extension of the static model consistent with a recursive cobweb model is attempted. It is considered a shift to the left of the supply schedule. That is, we consider what would be the net loss to society as the technological improvement disappears. In Figure 2 the shift is illustrated as a movement from S to S'. As a consequence of the shift in supply from S to S' due to the disappearance of the technological improvement, production will fall by EA. Of this cut in production, $E'A$ occurs due to fall in productivity of the same quantity of factors already employed in the sector. Therefore, consumer surplus falls by $E'ABB'$. The fall in production EE' is due to shift of resources out of the sector. This has opportunity cost of $EE'G'G$ which is a gain, but there is also a loss of consumer surplus $EE'FB'$. Therefore, the net gain due to the liberation of resources is $FB'GG'$. In the new situation the adjustment cost (or welfare cost of disequilibrium) is HGF. Net cost saving in adjustment equals $FB'GG' - HGF$. Net social returns equals $E'AB'B - (FB'GG' - HGF)$. As can be seen, it is possible that the technological improvement may impose a social cost; this occurs when net cost saving in adjustment is greater than the loss in consumer surplus.

Comparing the analysis done in Figure 2 with the one done by Ayer and Schuh, it is possible to observe basic divergencies. How big the discrepancies are, and in which direction they occur, is an empirical question since these depend on the magnitudes of the parameters involved.

Saylor criticized the partial equilibrium approach of Ayer and Schuh, but he uses the same framework in his own computations of social returns.

Valuation of Additional Output and Inputs

Since cotton is a tradeable commodity, and it is well accepted that there have been distortions in the exchange market, the additional total output obtained with the introduction of new varieties (EA) should be valued at the world price times the shadow exchange rate. This method is independent of the actual policy the government has pursued. Neither Ayer and Schuh nor Saylor uses it.

None of them subtracts from the social returns the cost of additional resources used to expand production by EA. These resource costs are the extra cost of the new seeds and new inputs used in the pro-

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* The author received helpful comments on an earlier draft of this paper from G. Edward Schuh.

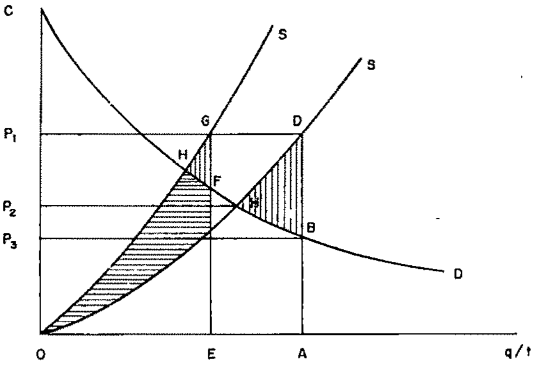

Figure 1. **Social returns due to supply shift**

duction of *E′A*. The cost of all inputs to produce the additional production *EE′*, here shadow price of labor in rural areas, should be used for valuation of the additional labor employed in the sector.

Estimation of the Shift Parameter

Ayer and Schuh estimate the shift parameter *k*, based on controlled experiments. Yields of new varieties controlled were compared with yields of traditional varieties *also* controlled. Though the absolute levels would be biased upward with respect to yields obtained at farm levels, relative changes in yield would diminish the bias appreciably. They made the comparison between yields with respect to a base period of time. The latter would present problems due to differences in other factors that affect agricultural productivity (e.g., weather conditions, diseases, and insects).

Saylor's main criticism of the Ayer-Schuh methodology has centered on their estimate of the shift parameter *k*. He argued that using data from controlled experiments overestimated the true *k*. Instead he proposed an estimation based on data generated at the farm level. He develops a new shift parameter *k′*. He considered average fiber yield per year and compared it with an average yield of a base period of time. His method of estimating *k′* has serious drawbacks:

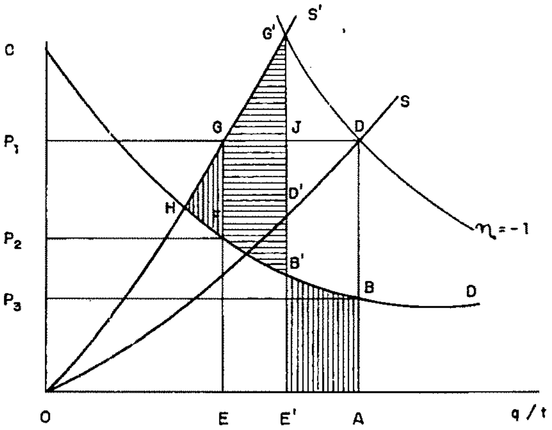

Figure 2. **Social returns due to supply shift**

(1) He mentioned problems of general equilibrium, but he also ignores them when estimating this shift parameter. As seen above, one consequence of the technological improvement, when demand elasticity is greater than one, is that resources will be coming into the progressive sector, since the only way to return to equilibrium from the new level is a fall in productivity. Therefore, it is expected that less productive land will be absorbed by the sector. As a consequence of that, Saylor's shift parameter takes into account the full adjustment process that took place after the initial shock of pure technological innovation. This by itself is a third best estimate of the shift parameter, which certainly will be an underestimation of the true one.

(2) By considering relative changes in yields with respect to a base period at time *t*, he is considering a shift parameter that includes *all* factors affecting yields, and not only changes in varieties. He takes a moving average of three years of his *k′*, and in doing so he claims that his resulting *k′* is an estimate of the varietal influence alone. In my judgment, it is not possible to change the conceptual meaning of data by taking averages. This average is also an average of net overall effects of factors that affect the shift in supply.

(3) The fact that Saylor obtained negative *k′* says nothing with respect to changes in varieties. Economists, and scientists in general, have to respect the *ceteris paribus* condition if they want to isolate the effect of a given variable. The right question is, "What would be the yield if the traditional varieties were planted instead of new ones, other things equal?"

I agree with Saylor that data from experimental plots tend to overestimate the true yields. But the *relative* change in yields should not differ much from that obtained at lower levels.

None of the shift parameters are perfect, but for the consideration mentioned, the Ayer-Schuh estimates are at least second best estimates. The main advantage of their *k* is that it is based on approximately constant sample land. By doing sensitivity analysis, as they did, one can get to know the changes in social returns.

Saylor's "Pessimistic" Rate of Return

In estimating his "pessimistic" rate of return, Saylor makes a serious methodological error. He apparently was not aware that his cash flow has more than one sign reversal, in which case, according to Descartes' rule, multiple rates of return will be obtained; their number will be at least equal to the number of sign reversals in the cash flow. Therefore in those cases the rate of return criteria and rule of decision cannot be used. Saylor's conclusions from his estimated "pessimistic" rate of return therefore simply do not follow.

Suggested Model

It is not possible to compare the rate of return obtained with the Ayer-Schuh analysis or the alternative model shown above with rates of return obtained in studies using static models. It is necessary to put all rates of return on the same basis before it is concluded that one rate is abnormally high.

As was shown, a shift in supply with a cobweb model generates two effects: changes in consumer surplus and changes in cost of disequilibrium. With the more conventional static model only the effect on consumer surplus is obtained.

It would be useful to re-run the calculations also with a static model, considering a given world price and valuing the increases in output using the shadow exchange rate. In computing cost, shadow prices should also be used in valuating additional quantities of resources employed.

In Figure 2, if we define P_1 as the world price times the shadow exchange rate, the social cost of not having the new technique is the foregone export receipts $E'ADJ$ less the excess opportunity costs of resources freed $GG'J$. The supply curve OS' should be corrected, when shadow wage is used; that will imply some downward shift in OS', and therefore $GG'J$ will be smaller.

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SOCIAL RATES OF RETURN AND OTHER ASPECTS OF AGRICULTURAL RESEARCH: THE CASE OF COTTON RESEARCH IN SÃO PAULO, BRAZIL: FURTHER COMMENTS

Musalem's contribution [6] closely parallels my earlier comment [7] on the Ayer-Schuh paper (cited as A-S hereafter), and I am in basic agreement with his general themes. He reiterates my criticism that the partial equilibrium model employed by A-S will tend to overstate the true internal rate of return to research when the analysis is re-cast in a general equilibrium framework. This overestimation occurs because the partial equilibrium model is unable to track resource movements into crops benefiting from research and the resulting impacts on input prices and the production of competing crops. He also repeats my argument that yield increases depend upon the use of complementary inputs such as fertilizers, sprays, and extension services and that these costs should be considered in arriving at a more accurate estimate of the social returns from research. To operationalize the above criticisms of the A-S model, it is clear that a sequential general equilibrium model would be required to trace out the resource shifts induced by research efforts and to estimate input shadow prices. Even if such a model were readily available, the lack of necessary data on inputs and outputs over a 40-year time period would prevent the actual use of the model.[1] For these reasons I pursued the well-trodden path laid by A-S and others in falling back upon a partial equilibrium model, noting, however, that these estimates should be considered "upper-boundary" estimates. Musalem criticizes this approach but makes no attempt to estimate his even less ambitious proposal. We are thus left with the A-S and Saylor methodologies to develop "upper-boundary" estimates.

A recent examination of Ayer's original thesis [1] suggests an additional methodological problem with the A-S estimates that leads to upward bias.[2] A-S are attempting to estimate "The returns to Brazilian society from São Paulo's cotton-breeding program . . ." [2, p. 559]. The demand equation used to estimate consumer surpluses accruing to the Brazilian society, however, is the sum of domestic and foreign demand for cotton fiber from the South of Brazil. Ayer in discussing equation (1) of the A-S paper states:

> The coefficient for the quantity of cotton fiber from the South of Brazil ($\overline{QCFS}$) implies a rather high price elasticity of demand . . . Economically, such a high elasticity may be explained by the fact that exporters face a perfectly elastic demand for their product, and their demand for cotton fiber will in turn tend to be elastic (although not perfectly elastic). Since total demand includes the demand for fiber by exporters, and exports constitute a high proportion of production (often over 50 percent), the total demand for fiber may well be quite elastic. [1, p. 120]

Since foreign demand constitutes such a large proportion of the A-S demand equation, a percentage of the change in consumer surplus due to São Paulo research is not in fact captured by the Brazilian society but rather accrues to world society. The relevant demand curve from a strictly Brazilian point of view lies downward and to the left of the curve used by A-S. This problem must be faced as long as the demand curve has some negative slope. In the extreme case that I used, *viz.*, an infinitely elastic demand curve and a perfectly inelastic supply curve, which incidentally also gives the largest possible estimate of the social benefits from research, this problem does not arise since all social benefits are captured by producers, i.e., there are no consumer surpluses. Lines 1 and 4 of A-S's Table 3 are consequently overestimated for this reason alone.

While agreeing that data from experimental plots tend to overestimate true yields, Musalem criticizes my use of farm-level yields to estimate the shift parameter K' and argues that this will lead to a third-best estimate. The basis for Musalem's position depends, among other things, on a rather vague notion, twice repeated, that "Though the absolute levels would be biased upward with respect to yields obtained at farm levels, relative changes in yield would diminish the bias appreciably" [6]. If I understand his point clearly, Musalem is hypothesizing that changes in farm-level yields will tend to be proportional to changes in experimental yields. I am not aware of any empirical work supporting this hypothesis, and Musalem's assertion of the hypothesis is not convincing. In fact the import of my pessimistic case was to suggest that it is possible for research to impose costs upon society if varieties are bred which are less suitable to the local environment than traditional varieties.[3] In such circumstances, yields from "improved" varieties may fall below the yields of traditional varieties. For example, Table 1 of my earlier comment shows that farm-level yields were consistently below the base-period yields between the mid-1930s and the mid-1950s. Musalem argues that this yield pattern may be partly due to extension of cultivation to more marginal lands. There is no historical data on the soil fertility of the cotton-growing areas or shifts in the location of cotton to test this possibility. Aggregate data [4], however, indicate that the total area planted in cotton was relatively stable from the mid-1930s to the latter years of World War II, when there was a sharp increase, and that area planted in cotton fell very rapidly thereafter until the mid-1950s, when the total area planted was less than the area planted in the mid-1930s. Such information is, admittedly, rather gross and does not rule out the possibility that the lands planted in cotton were gradually exhausted. However, the yield patterns show no definite cyclical downturn. Such information would appear to be at odds with Musalem's hypothesis.

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[1] Currie, Murphy, and Schmitz in their comprehensive review of economic surplus justify the use of partial equilibrium analysis by stating, "This is virtually inevitable, for the economist's limited knowledge of the complex interrelationships characterizing any economic system precludes any possibility of allowing for all the ramifications generally associated with a change in one particular industry" [3, pp. 787–88].

[2] I am grateful to Fernando B. Homem de Mello for pointing out this discrepancy to me.

[3] Such cases may evolve from a variety of circumstances such as the ability to control water supplies at experimental stations but which cannot economically be done at the farm level, or the breeding of higher-yielding varieties which are more susceptible to pests or diseases, e.g., higher-yielding sorghum and millet varieties in parts of Africa that are more vulnerable to bird attacks.

Musalem also criticizes my attempt to isolate varietal influences by using a three-year moving average. The three-year moving average was used primarily to remove the influence of stochastic events such as rainfall, pests, and diseases. In the absence of yield-increasing complementary inputs such as fertilizers and sprays, this moving average would be an estimate of the varietal influence alone. My comment clearly stated that I considered my K' shifter and the resulting rate of return to research to be overestimated because of associated joint-inputs. It is interesting to note that, although there are no published historical data on input use in São Paulo cotton production, it is widely believed that the use of fertilizers and sprays was minimal before the mid-1950s [4, 5].

Finally, Musalem suggests that I have violated *ceteris paribus* conditions apparently because some of my K's are negative. The right question he states is, "What would be the yield if the traditional varieties were planted instead of new ones, other things equal." I would have thought that the answer was perfectly clear from the methodology developed in the original comment. All other things equal, one would have expected the base period yield. The possibility of negative K's apparently was too surprising.

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SOCIAL RATES OF RETURN AND OTHER ASPECTS OF AGRICULTURAL RESEARCH: THE CASE OF COTTON RESEARCH IN SÃO PAULO, BRAZIL: REPLY

In our original article we explicitly noted that our analysis was for the most part conducted in a partial equilibrium framework and also acknowledged that our high rate of return *might* have been at least in part an artifact of this approach. Saylor took us to task for ignoring general equilibrium effects, but then did the same thing himself, with perhaps more serious consequences. Musalem repeats the charge and shows how the estimates can be obtained so as to account for the general equilibrium effects. Although Musalem's attempt is at least constructive, we think his approach is in error and leads to a distortion of the possible magnitude of failing to account for general equilibrium effects.

Before discussing what we believe to be his error, it might be useful to review why we did what we did, and why we used the approach that we did. First, the case of cotton research in Brazil seemed to be of interest in a number of respects. For one thing, although there was growing evidence from the U. S. that the rate of return to agricultural research in this country was quite high, there was little evidence on what the rate of return was in low income countries. The case of cotton research in Brazil appeared to be a good opportunity to develop some information on this problem.

But the Brazil cotton research program was interesting in another respect. Previous studies of the return to research had stressed the returns to technical change as a consumer surplus. Given the importance of exports in the Brazil case and the relative unimportance of Brazil in world cotton markets, it seemed clear that a major share of the direct gains had gone to the producer. In fact, in our judgment it appeared that most of the gains would have gone to the producer had it not been for Brazilian trade policy which channeled some fraction of the direct benefits to the Brazilian consumer. Hence, the Brazil case appeared to offer an opportunity to consider this aspect of the problem, which at that time had not received much attention in the literature.

The challenge of the research was that in Brazil data are limited and sometimes of questionable quality, and empirical studies of the cotton or other sectors are relatively few in number. As in other studies of the rate of return to research, it seemed clear that we were only going to have an approximation.

In part for this reason we decided rather early not to give explicit attention to the general equilibrium effects. We did this because we expected them to be largely second-order, and because we were going to be ignoring other benefits of the technical change which in our judgment were probably larger than the expected general equilibrium effects. Since these other effects were not discussed in the original article, it may be worth listing at least a couple of them at the present time.

1. The value of cotton to the Brazilian economy was undervalued. Brazil has over-valued its exchange rate for fairly long periods of time, and at times it has over-valued it rather seriously. In addition, during some years it placed export quotas on cotton in order to channel output to the domestic market. By valuing cotton at domestic prices, we were valuing it at less than its world opportunity costs. Although consumers gained relative to producers by virtue of this policy, there was presumably a cost to society, with the result that Brazil did not fully capitalize on the investment in research and development that it was making.
2. The research program helped make cotton a viable crop at the time that coffee was moving out of the state. The fact that cotton was a relatively labor-intensive crop probably helped alleviate the unemployment which might have occurred (and probably did occur) as the highly labor-intensive coffee crop declined in importance in the state. There are no data by which this can be assessed, but it appears that in some periods the contribution of cotton in this respect was substantial. In addition, there were probably indirect effects through the export multiplier from the increased exports which the research program made possible, and very likely some quality changes not reflected in price that occurred because of increased length, greater strength, and a finer fiber. These also were ignored.

It was our judgment that these factors, plus the fact that the improved seeds were used in other parts of Brazil and not accounted for in the analysis, would permit us to ignore the general equilibrium effects. The remaining problem was the complementary inputs such as fertilizer, for which there was only limited data, and various judgments to the effect that they were important only in the more recent period. For this reason we chose to follow the procedure used by Griliches with hybrid corn, in the sense that we attempted to isolate a pure variety effect by linking and adjusting the "experimental" results that we had available.

Of course, whether we were safe in assuming that the general equilibrium effects could be ignored depends on the expected magnitude of the effect. Musalem's Figure 2 suggests that the adjustment costs might be fairly large. However, we believe that Musalem's analysis, although correct in principle, is technically wrong. Although he takes us to task for not following Peterson directly, he also fails to follow him, and on a very important detail.

Consider Figure 1, and compare it with Musalem's Figure 2. The difference between them is that Musalem places his demand curve of unit elasticity considerably above and to the right of the actual demand curve. We have followed Peterson in causing them to intersect at the initial starting part. We believe this is appropriate, because the purpose of the analysis is to consider the incremental changes from an initial starting point, just as Peterson did, with the comparison being between a demand curve of unit elasticity of demand and one with a different elasticity.

The point of the recursive model is that a price of *P* in period *t*-1 would lead to a level of output in period *t* of *OE* if the supply curve had not shifted, and *OA* if it had shifted. The flow of benefits is estimated by assuming that the technical change is withdrawn and is calculated as the net loss to society that would result from this withdrawal.

Let us accept Musalem's analysis and follow it through in the new configuration. As a consequence of the shift in supply from *S* to *S'*, production would fall by *EA*. Of this reduction in output, *E'A* occurs due to a decline in productivity of the same quantity of factors already employed in the sector. Therefore, "consumer surplus" falls by *E'ABB'*.[1] The decline in output represented by *EE'* is due to a shift of resources out of the sector. These have an opportunity cost of *EE'G'G*, as represented by the supply curve, and this is a gain. But there is also a loss of consumer surplus in the amount of *EE'FB'*. Therefore, the net gain due to the liberation of resources is *FB'GG'*. In the new situation the adjustment cost (or welfare cost of disequilibrium) is *HGF*. Net cost saving in adjustment equals *FB'GG'* − *HGF*. Net social returns equals *E'AB'B* − (*FB'GG'* − *HGF*).

Now, the way Musalem drew his figure—or better, his positioning of the demand curves—makes the area *FB'GG'* appear to be large relative to the sum of *HFG* and *E'ABB'*. However, if the analysis is done with the two demand curves intersecting at *B*, as Peterson does and as we believe is correct, the size of *FB'GG'* is small relative to the sum of the other two areas. The size of this area will depend on the magnitude of the difference in elasticity of demand of the actual demand curve and one, and the size of the supply shift.

It was our judgment that the magnitude of these effects would be smaller in magnitude than the benefits that we were ignoring. In light of the fact that much labor was being released from the coffee sector at the time that cotton production was expanding, this did not seem unreasonable. It seems clear that these resources did not have zero opportunity costs. But at the same time their opportunity costs must have been relatively low.

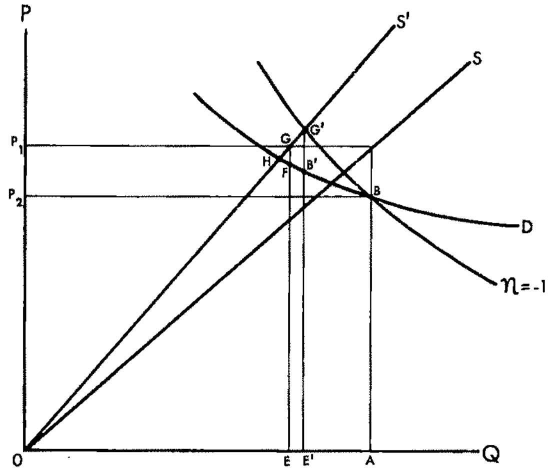

Figure 1. **Change in social returns under alternative supply and demand conditions**

We agree with Musalem that we should have estimated the rate of return from a static model in order to facilitate comparison among the studies. We have done this by abandoning the recursive model and assuming a perfectly elastic supply curve (with the demand elasticity of −5.3). Both Peterson and Griliches used this approach and pointed out that it gives a conservative estimate of the rate of return. It should be noted that in this case all the benefits of the new production technology are realized as a consumer surplus. The estimated rate of return under this assumption is 89 percent.

Mr. Saylor has shared a copy of his reply to Musalem with us. We would like to make two comments on it. First, he observes (based on a suggestion from Fernando Homen de Mello) that because our demand curve is negatively sloped and trade is important, our rates of return are returns to world society and not to Brazil. This issue hinges critically on whether the foreign demand for Brazilian cotton is perfectly elastic or not. Since our demand equation is the sum of domestic and foreign demand for cotton fiber from the South of Brazil, and since the estimated price elasticity is smaller than infinite, there is some presumption that the foreign demand for Brazilian cotton has a price elasticity something less than infinite. If that were the case, then foreign consumers would have shared some of the benefits of the technical change.

We did not address ourselves to this question in part because we did not have that much confidence in the estimate of the demand elasticity. Brazil has not been all that important in world markets, and the presumption would be that it was basically a price taker.

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[1] Musalem has followed Peterson in referring to this area as "consumer surplus." In fact, this would be better described as net social benefits, since it involves elements of both consumer and producer surplus. We have maintained Musalem's terminology to avoid confusion.

In addition, export policy was restrictive. The cruzeiro was seriously over-valued during much of the period covered by the study, and export quotas were often used. As we indicated, our judgment was that the foreign demand was high or nearly perfectly elastic, and such benefits as the consumers did receive was due to the trade intervention policies. Hence, although domestic prices probably did decline as a result of these policies, there is no presumption that the foreign consumer benefited from them.

A footnote to the effect that the estimated elasticity implied a less than perfectly elastic foreign demand curve, with the implication that possibly part of the benefits of the technical change were going to the foreign consumer, would perhaps have been in order. Given the relative unimportance of Brazil in world markets, and the restrictive nature of trade policy, we just did not believe that benefits to foreign consumers were that great. And we believe the text makes it clear that in our judgment Brazilian consumers benefited largely because of trade restrictive practices rather than because Brazil's output influenced the world price.

Our second comment has to do with Saylor's vacillation on certain issues. In his original comment on our paper he took us to task for ignoring general equilibrium effects and for failing to deduct the costs of fertilizer and other purchased inputs (not recognizing that our estimates of *k* attempted to abstract from these). When Musalem criticizes him for also ignoring general equilibrium effects, he responds by noting that to account for them is too complex (apparently not recognizing that Musalem suggests a feasible way of accounting for them), argues that everybody does it that way, and then appeals to authority. On the issue of fertilizer use, he justifies his own approach on the grounds that "it is widely believed that the use of fertilizers and sprays was minimal before the mid-1950s." Clearly, one cannot have it both ways on either count.

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Reviews are listed alphabetically by authors.

Book Reviews

Bauer, P. T., *Dissent on Development: Studies and Debates in Development Economics*, Cambridge, Harvard University Press, 1972, 550 pp. ($15.00)

This volume consists of a collection of Professor Bauer's papers, almost all of which have been published in substantially the same form during the past two decades. The collection is organized into three subdivisions of which the first is by far the longest. Part I ("Ideology and Experience") surveys Bauer's approach to a number of standard themes. The doctrines of a "vicious circle of poverty" and of "a widening gap" between rich and poor countries are dismissed as lacking empirical foundation. Foreign aid is treated as more likely to have a negative than a positive impact on legitimate development efforts on the principal ground that international transfers of resources should be undertaken on commercial terms if their utilization is to be effective. But the harshest judgments are reserved for those who hold that comprehensive planning has a useful role to play in promoting economic improvement in poor countries. Within Bauer's frame of reference, significant intervention by the state in the allocation of resources necessarily implies an unfortunate distortion in economic performance and invites socially iniquitous coercion. These themes are further elaborated in Part II ("Case Studies") in which Bauer resurrects some of his discussions of marketing boards in West Africa and of India's balance of payments. Part III ("Review Articles") is a compilation of Bauer's criticisms of the development literature of the 1950s and 1960s.

Those already familiar with Bauer's work will find no surprises here. But there is one element of novelty—or at least of heightened explicitness. In the author's introductory gloss on these materials, the reader is enlightened on some of the basic presuppositions which inform the approach. Why, Bauer asks, are the standards of development economics so "unduly low"? Part of the answer, he suggests, is to be found in a "systematic bias" which "probably reflects the pursuit of unacknowledged objectives which often have political or emotional bases" (p. 20). In particular, he maintains, many of the opinion-makers in the developed countries are people who "have come so to dislike major institutions of western society, especially the market economy and its corollaries such as private property, that they regard the radical weakening of these institutions as a major objective of policy" (p. 20). Such attitudes, in turn, are allegedly re-enforced by the "operation of widespread feelings of guilt in contemporary western society" (p. 21). It is further suggested that a factor underlying the "emergence of these feelings of guilt could well be the erosion of a sense of personal sin, which in turn reflects both the de-emphasis of the individual compared to the collectivity and of personal responsibility compared to environmental influences" (p. 22). Moreover, it appears that this sense of guilt is necessarily the enemy of detached analysis of the development process. Bauer writes: "The obstacles to the adoption of technical reasoning and the attitudes appropriate to it are accentuated in this sphere by an overwhelming concern with policy, even more intense and pervasive than in other branches of economics. This concern is so intense that it has lent a missionary and almost messianic tenor to much of the discussion, which is inappropriate to a technical subject" (p. 289).

While others may have faltered, Bauer makes clear that his own faith is unshaken. Under his stewardship, the doctrines of classical liberalism are alive and well—at least as instruments for passing judgment on the modern world and on other commentators on development economics. Bauer's writing has both the strengths and the weaknesses of uncompromising consistency.

A venerable tradition, to be sure, underpins this perspective in political economy. Nevertheless, the form in which it is articulated in this volume is not fully satisfying. The study of economic development has moved some distance during the period in which these essays were written. A number of the approaches which dominated discussion in the 1950s have been recognized to be less than fully adequate by some of the analysts who first recommended them. Unfortunately, these shifts in the contours of debate get little recognition from Bauer. Doggedness runs the risks of being both repetitive and out-of-touch with the living reality.

It is disappointing too that Bauer does not respond more directly to the doubts of many economists who do not share his faith. The position of those who lack complete confidence in the alleged optimizing effects of uninhibited market forces in poor countries cannot be explained fully by the political and emotional biases to which Bauer attaches such weight. The concerns expressed in much of the recent discussion about the significance of agrarian structures (in which production for exchange is far from ubiquitous) and about the implications of the post-war demographic explosion for poor countries largely escape his notice. Unhappily, the term "debates" in the sub-title of this work is a misnomer.

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Bird, Richard M., *Taxing Agricultural Land in Developing Countries*, Cambridge, Harvard University Press, 1974, xvi + 361 pp. ($14.50)

This book, a product of the Harvard Law School International Tax Program, is a study which goes well beyond law or even the bounds of conventional public finance. It can best be described as the developmental political economy of land taxation. Its geographic scope embraces all major regions in which developing nations predominate, plus some historical studies of land taxation in presently developed nations. In addition to this broad empirical base, the book covers a broad frontage of theoretical analyses and integrates the empirical and theoretical materials into a well-defined, yet comprehensive examination of tax policy issues.

Initially Bird identifies general issues related to tax policy which are drawn from contemporary economic development literature. He also demonstrates empirically the widening divergencies between the tax policies recommended by development analysts, especially those of the two-sector model inclination, and what governments of developing countries are actually doing. This sets the stage for analysis of the varied structures of tax systems and the reasons for administrative successes and failures in meeting the objectives assigned to them. The book then analyzes conceptually the incidence of various types of taxes, their allocative and developmental effects, and the social and power relations which are likely to affect land tax administration systems under varying sets of assumed conditions. In the concluding chapters the various aspects of the analysis are brought to a focus in a general appraisal of the strategies and possibilities of land taxation as an instrument of economic development policy in the social, political, and administrative context of developing countries. This appraisal emphasizes the potentials of land taxes as means to improve local government services.

The thoroughness and scope of this study is remarkable in a volume of only 295 text pages. Its thoroughness is indicated by the bibliography of about 350 separate items. While only rudimentary formal statistical material is presented to test specific hypotheses, an impressive quantity of evidence, especially case analyses, is provided to show (a) that, in general, agricultural taxes, and specifically land taxes have declined in importance over time, (b) that they have been ineffective substitutes for land tenure reforms and other programs designed to redistribute incomes and wealth, and (c) that with minor exceptions sophisticated systems based on an imperative of extreme equitability and designed to serve multiple functions have generally failed.

The strength of this book is its success in isolating and analyzing policy alternatives in this much neglected area of subject matter. It is made possible because the author recognizes that meaningful policy analysis must isolate and address itself to the strategic characteristics of the political, social, bureaucratic, and economic matrix of the problem situation. The issue is the isolation of the best of severely restricted alternatives, not the development of theoretically ideal but unworkable programs. For example, he opts for crude but workable systems based on gross land classifications and land measurements based on aerial photographs in cases where cadastral surveys are expensive and time-consuming, revenues in short supply, and administrative personnel overloaded. He leans heavily toward earmarking land taxes for use in services needed by agriculture and rural people especially at a local level to make them politically more acceptable and administratively more enforceable. But most of all he pleads for careful analysis of the unique facets of each situation including the historical antecedents of politics, public administration, and tax policy which determine available options.

The multifaceted analysis provided in this book will provide opportunities for criticism by disciplinary specialists, especially economic theorists. Scope in analysis has its price; but in this case the net value of the study is immensely enhanced by its broad problem-focused approach.

A format feature which virtually destroys the value of extensive documentation and footnoted qualifications of the author's arguments is the placement of all footnotes at the end of the entire text where all but the most dedicated readers will pass them by.

This reviewer has no reservation in recommending the book for inclusion in personal libraries of agricultural development specialists and academic institutions, especially those with programs in public finance, public administration, and economic development. But it would be especially valuable to technical assistance agencies and indigenous agencies of developing countries with responsibility for fiscal, land, and agricultural development policy, an effective prophylaxis against analytical tunnel vision in a field which has suffered greatly from it.

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Hardin, Charles M., *Presidential Power and Accountability: Toward a New Constitution*, Chicago, University of Chicago Press, 1974, vii + 257 pp. ($7.95)

This is more than merely another in the spate of recent books illustrating how domestic and foreign political developments in recent decades have encouraged the amassing of power in the American Presidency which permitted the nearly successful *coup d'etat* generically referred to as the Watergate scandals. In this study, Professor Hardin, best known for his studies in U. S. agricultural politics, argues that faults in the structure of the American Constitution and government—not merely the abuses of one administration—have become so critical that major constitutional reform is necessary to restore a limited government, that is to say a truly constitutional system here. He thus proposes a series of constitutional alterations that he believes will reestablish a healthy balance of power between the president and Congress as well as between the federal government and the people.

Major constitutional amendments are necessary if we are to maintain and control a vigorous president; to reestablish the "writ of the general government over the bureaucracy; and to invest public policy with greater internal coherence and more pre-eminence over the 'importunities' of pressure groups," Hardin insists. As he sees it, his proposed constitutional revisions will help resolve the social and psychological tensions arising "when a limited and divided—indeed, a splintered—government confronts the problems of a collectivist age" (p. 20).

He admits that none of these points will dissipate the danger inherent in sweeping reforms. But, he argues rather unpersuasively, that his statements on constitutional reorganization should "obviate any attempt to kill them off with the pejorative tag that they are merely 'tinkering with the machinery.'" Some readers will wish that in the course of the book he would have mounted a more organized and convincing position to strike down this reasonable though skeptical view of mechanistic machinations.

Professor Hardin, nonetheless, recognizes at the outset that any proposals for reform must be constrained by a key premise of constitutional democracy, namely that it must be a marriage of the popular will to limited government. Also given the far-reaching quality of his proposed constitutional amendments, he wisely recognizes that the proposals are highly debatable. He does not make known as clearly his appreciation of the enormity of the political and institutional obstacles in the way of changes that are so profound as to alter totally the heart of our constitutional and political system. The intention of the book, as he states it, is to contribute to public acceptance of the need for serious consideration of fundamental constitutional change.

The book begins with a look at the growth of presidential power from F.D.R. to Richard Nixon, and through the episodic use of examples he attempts to demonstrate how government by presidential whim or instinct is encouraged by the creation, inexorable but not necessarily intentional, of a cadre of yes-men constituting the White House staff.

Moreover, Professor Hardin argues, the federal bureaucracy has grown so autonomous as to be out of control of even the president. While the book was published earlier, recent hearings of the Judiciary Committee of the House of Representatives on impeachment of the president provide somewhat mixed evidence of this contention since some agencies such as the C.I.A. and to a lesser degree the F.B.I. seemed to bend easily to the whims of the executive or his assistants. Others such as the Internal Revenue Service exhibited what to many would be viewed as a praiseworthy degree of autonomy from presidential pressures.

The author argues in addition that the leverage of public opinion has been reduced by the rise of special interest groups controlling large blocs of votes, but in fact reflecting the views of a narrowly select few. Furthermore, he suggests that another fault of the system lies in the sovereign role assigned to the public by politicians and pollsters which means, in fact, that the public is given the impossible task of providing answers to policy questions while lacking the essential information or expertise. Thus public officials can and do claim the support of public opinion on almost anything they seek to do.

The control remedy for the unchecked and irresponsible power in almost every branch of government as Professor Hardin sees it is a series of constitutional amendments designed to create a new form and substance for our two-party system mainly as it operates nationally in the legislative and executive branches of government. Space prohibits more than a fleeting note of each of the nine major constitutional changes suggested, and detailed analysis is, of course, impossible. But since one purpose of the study is to encourage public awareness and debate for fundamental constitutional reform, some purpose may be served by essentially cataloging some of the key features of the proposals.

First, it is proposed that the President and members of the House and Senate be elected on the same date for four year terms, but this could be reduced at any time by the government in power and new elections could be called for in a fashion similar to the United Kingdom. Second, the House of Representatives should be supplemented by approximately 150 members selected at large by the party winning the presidency. Third, presidential candidates should be nominated by party committees composed of House members and candidates for election from each house district, and the Office of Vice President would be abolished. Fourth, the Senate would lose its power to approve treaties and presidential appointments. Fifth, the president's veto could be overridden by an adverse majority vote in the House of Representatives alone. Sixth, members of Congress would be permitted to serve in other offices of the United States. Seventh, the runner-up in the presidential election should be designated leader of the opposition and provided a privileged seat in the House of Representatives. Eighth, presidential elections should be by national ticket with only a national plurality vote necessary for victory. Finally, the 22nd amendment should be repealed.

The momentousness of these changes is obvious to all. What is not so obvious is the technique that should be employed to accomplish this end particularly in light of the well-documented public apathy or antipathy to complicated constitutional alterations leading the nation into uncharted waters. This coupled with ingrained institutional opposition by policy makers and administrators may appear to some readers to reduce such proposals to academic exercises concerned with the form rather than the substance of government.

It would be hard to deny the intellectually challenging qualities of Professor Hardin's suggestions. Unfortunately, the curious structure and organization of the work make it extremely difficult to follow the full force of the rationale as it develops to support fully each or all of the proposals. Nonetheless, the book is an interesting contribution to current literature on the constitution and the contemporary presidency.

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Johnson, D. Gale, *World Agriculture in Disarray*, New York, Macmillan (cloth), Fontana (paper), 1973, 304 pp. ($10.95 cloth, $4.95 paper)

This is the best overall analysis of international trade and agricultural policies that has appeared in some years—perhaps since the author's last general title on the subject, *Trade and Agriculture: A Study of Inconsistent Policies,* which appeared in 1950. One would expect it from Professor Johnson who is preeminent amongst us in this complex field. Two strong assertions? The study itself justifies the first, while my subjective evaluation of the author is based on a quarter-century of observation in a variety of circumstances. After this opening, can the reviewer suggest any improvements in the study? A few—to be noted shortly.

The book is theoretically sound and offers pragmatic suggestions to the industrial countries of the world, around which a case is built for reducing the enormous costs which have been imposed upon taxpayers and consumers and for rectifying the damage which has been done to the human resources engaged in agriculture. Through the years Johnson has used the basic tools of our trade to point up the conflict between domestic agricultural and trade policies. He has argued in many essays, some of which are woven into this study, in other contexts, such as Presidential Commissions, and in the classroom, where students have benefited from his Chicago-socratic method, that a large share of the income transfers that have been retained in agriculture have gone to increase the returns to land and capital and that these transfers have been capitalized into the value of land.

Should the policies of the post-WW II era be maintained, governments of the industrial countries will awaken a decade or so hence to the fact that exactly the same set of problems exists as existed in 1972, in 1962, or in any other year in modern times. In arguing this thesis the author probably would agree with the reviewer that if modifications are not made in such policies, even disorders and changes such as we have witnessed in 1972–73—high farm prices, consumer shortages, and relaxation of age-old trade barriers—will transport us to a higher plateau only to be confronted with the same jigsaw puzzle between prices and costs. Trade-wise, protection is likely to be more rigid, barriers such as import quotas more overt and restrictive, and export subsidies larger and more pervasive. Such a situation is already upon us in the sudden surplus in world meat supplies. As of July 1974, Japan had placed a total embargo on beef for the rest of the year, Canada had placed a total restriction on U. S. beef, and the U. S. cattle industry was clamoring for reinstituting import quotas—while retail prices of beef are just short of record levels.

One would expect Johnson to emphasize, as is the case with his colleague Ted Schultz, that the real danger of high-cost, historically-entrenched farm and trade policies is an inadequate investment in the rural poor. To those with assets and political power go the spoils of protection and vested interest. This is true, not only in this country, but in other industrial countries as well. Who ultimately benefits from the high variable levies on grains in the EEC? Not the French peasant, but the large wheat farmer in the Paris basin. The poor in agriculture suffer because they are not adequately prepared to make that inevitable adjustment that economic growth demands they make in a dynamic, industrial world society. The money is placed on farm and rural assets, not on people.

The analysis clearly shows that agricultural protection contributes little or nothing to the long-run solution of the farm income problem. That is, high prices alone are meaningless for that goal, and a *continuously increasing degree of protection* and *continuously increasing real farm prices* are necessary to maintain or increase the relative income position of farm families. Equally clear is that a phased and gradual reduction in the level of farm prices in the industrial countries to an approximation of the world market levels might significantly lower farm rents—hence, land values—but would have little effect on the long-run and relative income position of farm labor, including the labor of farm operators. Here in a nutshell is the reason land owners in countries like France, Germany, Italy, and Switzerland have clamored for high protection policies throughout modern history. The U. S. has a mixed record.

The most innovative part of the analysis are those places throughout the text where the concepts of *effective protection* and *value added* in agriculture are discussed. The former is a relatively new tool of measurement refined by trade theorists to go beyond the old concept of nominal protection to a new understanding of protection in traded goods. The latter is helpful to Americans in thinking in terms of value added—a system of measurement being rapidly adopted in Europe for Common Market accounting purposes.

Here are a few critical suggestions. First, as to writing style and manuscript organization, while such a book is not intended to be bedtime reading, the long sentences, especially where they contain data or points for illustrating principles, could have benefited from some streamlining. Such a job is well within either Johnson's capability or the role of an editor with adequate time. Better editing would have caught the grammatical errors, e.g., the repeated use of the plural *criteria* (pp. 258–59) to identify the singular *criterion*. The chapters could have been more purposefully tied together. While the well trained of our profession will not suffer, the general economic reader will struggle with this aspect and with some redundancy in information.

I will take issue on two relatively minor points. In the opening pages (p. 18) farm people are pictured as being more progressive than the evidence warrants. The author states that ". . . as the story unfolds it will become evident that farm people are more willing to change . . . than the rest of us." Upon reading this I was incredulous, even though the supportive statements about farmers were acceptable. After studying the evidence and reflecting on personal experience, I am still disposed to doubt the statement. There is basis for argument, also, about exploitation of the farmer: not that he hasn't been exploited and his education neglected, but *why*.

A slightly more serious matter is the implication that there is really nothing new on the protection scene. Johnson in taking this position philosophically is in good company. Solomon in Ecclesiastes proclaimed, "There is nothing new under the sun." Harry Truman said repeatedly that ". . . the only new thing in the world is the history you do not know." Well, while all this may be true, it is misleading to suggest that trade and protection matters in the 1970s are not any different than those existing during the Mercantilist era or during the 19th Century. To be sure, protection existed in the 15th and 16th Centuries, but trade was marginal in most of the world, which was composed mostly of subsistence economies. The volume and content of trade alone today make a difference. There *is* something to the term "new protectionism" where administrative fiat is so important in the world of nontariff barriers, and in a world where trade in processed goods is so overwhelmingly more important than raw materials trade.

With this bit of dissent, I return to the positive! The book is an excellent addition to the literature and is recommended for wide use especially in graduate classes of agricultural policy and trade.

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Kelley, Allen C., Jeffrey G. Williamson, and Russell J. Cheetham, *Dualistic Economic Development*, Chicago, The University of Chicago Press, 1972, vii + 399 pp. ($12.50)

The time is more than ripe for students of economic growth for low income economies to return their interest to dualistic models, or perhaps more properly, models of structural transformation. For all too long the literature even for low income nations has been dominated by a view of economic growth as a function of a single factor of production, capital; an emphasis on steady state growth, with, by definition, an absence of structural change; and manipulation of planning models which take as exogenously determined the bulk of the variables which seem most determinant of the pace and pattern of economic growth.

The approach taken in *Dualistic Economic Development* grows from the neo-classical tradition—it is assumed that factors of production are paid their marginal product and there is not, of course, a pool of unemployed labor. The basic model presented is of a closed economy with single commodity agricultural and industrial sectors each including both laborers and capitalists. Each sector has a production function subject to the usual assumptions about its behavior and rules of optimization. Industry is assumed more capital intensive than agriculture; technological change is assumed to be labor saving in industry and labor using in agriculture; the elasticity of substitution of capital for labor is higher in agriculture than in industry; and fertility rates are higher in rural than urban areas. It is this set of contrasting assumptions for agriculture and industry which provides the basis for major effects on growth of structural change. The model has much to recommend it over the quite different two sector Uzawa type models, not only because of the emphasis on structural differences among sectors, but also because of the potential to examine Engel effects.

The model presented is complex and lacks the simple elegance of the Jorgensen model to which it is otherwise closely related [1]. However, it is this added complexity which allows analysis of a wide range of relationships and development issues within a rigorous general equilibrium framework. Further, the basic model is expanded in complexity of assumptions into a simulation model which allows exploration of an even wider set of relationships and facilitates testing against empirical evidence from a cross-section of contemporary low income countries. The simulation approach is then used for an intensive analysis of Japanese economic history, "the Japanese model," which is itself particularly insightful and constructive. It is this combination of theory and empiricism which makes the presentation of such interest. The addition to our knowledge of growth relationships and the clear demonstration of the unreliability of much conventional wisdom based on partial analyses are both of importance.

The findings are too numerous to more than sample. The authors exemplify much of their efforts with the finding that 1 percent increase in the savings rate provides, by the end of 10 years, a 2½ percent increase in the rate of growth of the capital stock and a 3 percent increase in the rate of per capita income growth. The authors then discuss the relationships involved—in this case complex effects of structural change on aggregate capital-output ratios and birth rates. This same type of analysis provides an interesting discussion and demonstration of the capriciousness of the "sources of growth" methodology and a useful presentation of the interaction of technology and capital in determining growth.

The analysis of the Japanese record emphasizes the key role of slow rates of population growth in explaining Japan's high rates of structural transformation and growth in other variables. However, in application to contemporary low income nations, note should be made of the considerably higher rates of technological change which appear feasible in contemporary agriculture, based on more advanced basic agricultural science and a larger backlog of scientific advance upon which to draw, as well as the evidence that in the context of broadly participatory growth, birth rates now appear to decline more rapidly than a generation ago, in relation to per capita income and income growth.

In the current context of highly biased technological change in agriculture, the model presented suffers notably from limitation of agriculture to two factors of production, capital and labor, and the ignoring of land. It is, however, the strong land augmenting bias of high yielding crop varieties which has such powerful stimulative effects on structural change, acting through effects on interpersonal income distribution and consequent effects on the consumption function (see [3]). The authors in contrast to the bulk of development literature do strongly emphasize the importance of the consumption function and changes in taste on structural change and hence on rates of growth, but they fail to capture the particularly important element of such change which arises from the rising factor share to land.

The assumption of increasingly labor intensive techniques in agriculture is central to a number of the conclusions and is probably demonstrably correct given the definitions used and the exclusion of land from the model; and yet a caution is needed that with new high yielding crop technologies, labor input is quite inelastic with respect to crop output, and the factor shares swing heavily towards land [2]. As a result of these assumptions, with growth, the terms of trade in the model turn against industry a finding contrary to most history.[1] Similarly the assumption of a fixed proportion of capitalists' income saved prevents capturing the effect of technological change on the rate of profit and hence on the savings rate—a consideration also of great importance to the agricultural sector.

The lessons then are many. Growth patterns are complex and varied. Consequently the search for a general theory of growth of low income economies is fruitless—although areas of special emphasis for analysis of low income economies can be indicated. Change in structure is itself a particularly important dynamic of growth, with wide ranging elements—suggesting the desirability of further disaggregation of economies for analysis of a more complex and larger set of sub-sectors. Finally, the book suggests a vast number of areas for fruitful further inquiry with respect to both conceptual and empirical analysis.

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[1] See, for example, an alternative finding in Uma J. Lele and John W. Mellor [2].

References

[1] Jorgenson, Dale W., "The Development of A Dual Economy," *Econ. J.* 71:309–344, June 1961.

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[3] Mellor, John W., and Uma J. Lele, "Growth Linkages of the New Foodgrain Technologies," *Indian J. Agr. Econ.* 28, No. 1, Jan.–Mar. 1973.

Lewis, W. Cris, Jay C. Anderson, Herbert H. Fullerton, B. Delworth Gardner, *Regional Growth and Water Resource Investment,* Lexington, D. C. Heath and Company, 1973, xi + 172 pp. ($14.00)

The four authors, all on the Economics faculty at Utah State University, state that this book was the outgrowth of a contract with the National Water Commission "to study the way in which investment in water resources might influence the pace and direction of economic growth." "The question of how such investment might influence growth is an important one, in that allocation of public funds in some cases has been at least partially justified on the expectation that economic growth would be accelerated and, thus, economic welfare increased, by such investment." The authors make the point that "both the theoretical and empirical support for such a position are incomplete" and it is their "goal to broaden the stock of knowledge on the question" [preface p. xi].

The presentation is in three major parts. The first attempts to develop a logical framework of analysis for regional growth in general; the second focuses specifically on the characteristics of water in relation to regional growth and examines a few empirical studies; the third looks at quantitative techniques for analysis.

Conclusions drawn in part one are that functional economic units (FEA's) should be the primary spatial unit for economic analysis; that while each of the three growth models examined contains useful features (export-base, neoclassical, and industrial models), none offers a comprehensive view of the growth process; and that regional accounts should include measures of "health and well-being."

Part two shows that the impact of investment in water on regional economic activity depends on demand for water as well as supply and that quantities of water used in nonagricultural activities are relatively minor inputs in the production process—usually no more important than other inputs. A model of a sequence of possible developmental impacts is presented. It is this section of the book that offers some persuasion from a policy viewpoint. The section concludes with a 3½-page review of empirical studies of water resource investment and economic growth. The paucity of available empirical evidence (four studies, each criticized for theoretical or research deficiencies) suggests the basic difficulty the authors faced in accomplishing their assignment.

The bulk of part three is made up of suggested *hypothetical* matrices to use in measuring water development impacts. Included are a "comprehensive water investment planning matrix," a "project area impact matrix," various Input-Output matrices, some programming matrices, some econometric model matrices, and a suggestion that simulation models might be useful in some cases also.

Finally, after a set of four hypothetical case studies are discussed, conclusions of their "synthesis" of theory, empirical evidence, and methods are drawn. The major conclusion is that "Under some circumstances, in some regions, there exist a class of investments that will expand the rate of economic activity. Under other circumstances, the same project may have little or no effect on the regional economy in question. Although, in some situations, a case-by-case approach must be used, general applications *might* be drawn and predictions made on the basis of previous analyses of regional-investment type combinations [italics mine]" (p. 166). "More research is needed" (p. 168).

The authors obviously had a problem. It seems apparent their own inquiry led them to no significant discoveries. However, in an attempt to fulfill a contractual obligation they undertook to review and rewrite in a formal (often mathematical) manner, materials and knowledge already available on the subject. Such an effort can be extremely useful in the development of new theory. However, in the context of what turns out to be a review of the literature, much of the effort seems merely pretentious and adds little to the current state of the arts on the subject. In summary, while this very academic book is not very long, it could have been shorter.

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Nelson, Michael, *The Development of Tropical Lands: Policy Issues in Latin America*, Baltimore, The Johns Hopkins University Press for Resources for the Future, Inc., 1973, xvii + 306 pp. $12.50.

Drawing on case studies of 24 settlement projects in the humid tropics of Latin America, Michael Nelson has examined the successes and failures of land settlement on the continent over the past two decades or so. He has drawn from his cases lessons about site selection, settler identification, infra-structure, and economic, technical, and administrative problems. His conclusions and policy recommendations, with some exceptions, are not surprising for those close to settlement programs: that directed and "semidirected" projects have, on the whole, not been as successful as the original expectations, and that spontaneous settlement has been more successful and less capital intensive. "Few spheres of economic development have a history of . . . failure to match that of government-sponsored colonization in humid tropical zones" (p. 265).

Nelson includes in his discussion many eminently sensible observations and recommendations to which little exception can be taken. He does, however, challenge the views of many transport specialists about how much in the way of complementary programs is necessary before viable spontaneous settlement along a new road can proceed. He comes down hard for more reliance on road construction, both penetration roads and feeder roads, instead of directed or even "semidirected" projects.

Given his implied support for more reliance on spontaneous settlement, Nelson is surprisingly ambivalent about "subsistence" farms. Although he does not state his concern clearly, he apparently feels that "subsistence" agriculture cannot lead to modernization through subsequent commercialization. Instead of permitting establishment of subsistence farms, he feels settlers should be enabled to have larger holdings which can have considerable market orientation—he avoids any size specification—and that there should be a mix of quite sizeable, fully commercial holdings. Not only can such a structure lead to commercialization, but it can also provide the basis for a local market which can support the development of urban centers without which, Nelson contends, little continuing development can be expected.

The core of Nelson's analysis is a group of cost-benefit analyses of his cases. Although these are appropriately done for the most part, too much space is devoted to a detailed discussion of cost-benefit methodology given that inadequate supporting data is supplied to be able to follow the case study analyses in detail. Of course, the reason is that of space limitation, but this being so, Nelson might well have omitted the detailed and not particularly novel discussion of methodology. More to the point is the fact that the cost-benefit analyses do not link closely to the discussion which follows about factors affecting development policy. So many of these factors really revolve around political and institutional questions—development strategy, project management, market organization, and the like—that one would have preferred more discussion of these factors than that provided by the highly summary case study presentations. Nelson does, however, make a good case for more careful formal advance planning (even for less highly structured settlement projects), including better project analysis, pointing out most analyses have been based on inadequate studies of the particular project area and have underestimated costs and overestimated benefits because of "deficient engineering, inadequate resource and marketing studies, and unrealistic production plans . . ." (p. 274). Given the high degree of uncertainty in settlement projects, he urges more use be made of probability techniques in preparing settlement analyses.

Nelson's book, although not path-breaking, is a useful drawing together buttressed by case study evidence of contemporary views in development circles about settlement in tropical Latin America. As such it is a good summary for those already in the field and a worthwhile starting point for those who may wish to familiarize themselves with current settlement issues.

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Paauw, Douglas S., and John C. H. Fei, *The Transition of Open Dualistic Economies: Theory and Southeast Asian Experience,* New Haven, Yale University Press, 1973, xii + 306 pp. ($12.50)

This book consists of case studies of a generation (1950–1970) of transition in four countries—Taiwan, Philippines, Thailand, and Malaysia. The idea of transition is the transformation of the economy from one that is ". . . primarily [an] agricultural economy containing an enclave dedicated to the export of primary products" (p. 3) to one where ". . . the economy's output is primarily created by human and capital resources, predominantly employed in the industrial sector" (p. 225). Of the four countries included in the study, only Taiwan has completed transition, and, as the authors note (p. 239), it is not at all clear whether transition has actually begun in Thailand and Malaysia.

The authors employ what they call a typological-historical approach which means that for each of the four countries a theoretical model is developed which takes into account some of the historical characteristics of the economies. In essence two basic models are developed: one for what is termed economic nationalism involving import substitution (IS) in Taiwan and Philippines and one for neo-colonialism involving export promotion (EP) in Thailand and Malaysia. The EP model is based on free market organization, and the theoretical conclusion is that this policy is doomed to fail at transition. The IS model is based on controls and forced profits transfer from the primary exporting sector to the industrial sector and may result in successful transformation if the conditions are right as was the case in Taiwan. In both the IS and EP models, foreign exchange earnings are primarily derived from

Table 1. Percentage rates of growth of manufactured goods consumption and primary export earnings during IS

Rate of Growth	Philippines 1950–56	Philippines 1957–59	Philippines 1960–65	Philippines 1950–65	Taiwan 1952–59
Consumption[a]	9.7	3.1	3.2	5.8	7.1
Export Earnings[b]	11.0	—2.9	6.9	6.6	4.3

[a] Derived from Tables 1 and 2 as $C = Y + M_y - E_y$ for Taiwan and Tables 3 and 5 as $C = Y + M_y - E_i$ for Philippines.

[b] Derived from Table 2 as $J = E_x$ for Taiwan and from Table 3 as $J = E_x + E_m$ for Philippines.

primary exports. Successful transition requires that labor and capital intensive (manufactured) exports replace primary exports as the principal source of foreign exchange.

Although the authors acknowledge the importance of the traditional agricultural sector in economic development, the book is about the export-import enclave and an emerging industrial sector. The formal models abstract almost completely from the traditional sector. As a consequence some of the economic assumptions are somewhat unrealistic. The following discussion of the IS model is an attempt to substantiate this claim.

In the IS model, exporters of primary products earn income (J) which is spent on either industrial consumer goods (C) or saved. Incentives are created to invest these savings in the domestic production of C through protective tariffs, and an overvalued exchange rate is used to transfer profits from the exporters to the importers. These transferred profits are invested in the C industry. If the policy is successful, domestically produced C replaces imported C.

The only buyers of C in the model are the exporters. The IS phase automatically terminates when the demand for C is met from domestic supply. In the IS model, none of the exporters' income is spent on food, so there is no flow of income from the enclave to the traditional agricultural sector. Conversely, only exporters are assumed to buy C from their export earnings since this is assumed to be the only income of importance, even when all C are produced domestically. However, at the point when all J is spent on domestically produced C, the income generated by the production of C must be at least as large as the value of the exporters' income which is spent on C. Even if C manufacturers spend some money on intermediate inputs, these inputs are all produced domestically by assumption and the value of these intermediate goods consists of returns to primary factors of production within the economy. Thus, at that point the industrial sector must generate purchasing power equal to the income of the exporters. However, that income is not taken into account either in investment or consumption.

To test the empirical validity of the assumption that J is the only relevant income in determining the demand for C, the rates of growth of C and J were calculated for Taiwan and Philippines (Table 1). Under the Paauw-Fei assumptions, the rates of growth should be equal. However, the data for Taiwan indicate that C grew much faster than J suggesting that other markets were important. During the period from 1955 to 1959, productivity in the agricultural sector rose by 24 percent (p. 233), and part of the increased purchasing power probably was used to purchase C. This rapid increase in demand was undoubtedly important in the success of Taiwan's IS phase. Regarding the Philippines, the rates of growth of C and J for the 1950–65 period correspond reasonably well, but the data for the three sub-periods suggest a different picture. Except for the 1957–59 period (when J declined), J grew faster than C. During the 1955–65 period, agricultural productivity declined and thus there was a declining effective demand for C from that sector. This source of potential demand is not incorporated formally into the model nor mentioned in the discussion surrounding the model. Similarly the role of the traditional sector as a source of savings is never mentioned. However, the potential supply of labor from this source is discussed and, indeed, the failure of transition in the Philippines is attributed to the fact that this labor was not forthcoming (p. 230), and the successful transition in Taiwan was ". . . enabled by the rapid growth of agricultural productivity" (p. 229). Neither of these conclusions are derived from the formal models. Thus, the success or failure of transition is determined by factors outside the models.

The models are not always consistent from one chapter to the next. For example, in Chapter 3 (p. 40) capital imports are determined as a residual after the import of C is determined, while in Chapter 7 (p. 136) imported consumer goods are taken to be a residual. In actual fact neither is a residual, and they are simultaneously determined since both depend on the market value of foreign exchange which is an endogenous variable in the model but treated as exogenous.

In summary, the theoretical models are oversimplified and abstract from some of the more crucial elements of the growth process. Failure to incorporate links between the traditional sector and the enclave precludes the analysis of policies to stimulate the traditional sector and the complementarities between the two which must be exploited for successful transition. However, in spite of this theoretical oversimplification, the empirical parts of the book are interesting, and much useful information can be gleaned from the case studies. The discussions of some of the policy recommendations and necessary prerequisites for development all seem reasonable and will be useful to students and policy makers. And although the models are oversimplified, they do provide an important step forward in constructing realistic models that take into account the openness of dual economies.

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Wong, John, *Land Reform in the People's Republic of China: Institutional Transformation in Agriculture*, New York, Praeger Publishers, Inc., 1973, xxiv + 319 pp. ($20.00)

The land reform and subsequent rural policies initiated by the Chinese Communist Party replaced a system of family farming by one of team farming.

This rapid organizational change that affected over 400 million rural people has no precedence or parallel in agrarian history. Mr. Wong's study describes how land reform took place and assesses this program, as well as certain policies that followed, in terms of their influence upon agricultural development. Does this work add significantly to our present knowledge of how land reform evolved, what it achieved, and how it influenced agricultural production in subsequent years? This reviewer believes not.

Mr. Wong briefly reviews Communist land reform policies in the 1930s and early 1940s, and then describes the application of the new agrarian reform law to north China and its implementation in other regions of the country. The author presents some new information on the timing and spread of land reform, but his findings still do not differ from those advanced by W. Hinton (*Fanshen*), D. and I. Crook (*Revolution in a Chinese Village*), and E. Volgel (*Canton Under Communism*). Nor does his description of the development of mutual aid teams provide a different picture of the evolution to cooperative farming than found in the studies of Kenneth Walker.

The final two chapters on how these institutional changes affected agricultural development are somewhat confusing and misleading. The author correctly shows that (1) land reform took place during rapid post-war rural recovery so that its real contribution upon output growth is problematic; and (2) very little productivity gains for foodgrains and cotton occurred immediately after land reform. But his discussion of the process of agricultural transformation implies that modern agricultural development commenced sometime during the 1960s when the state introduced new seeds and chemical fertilizers through the commune system.

An agricultural transformation should be defined as an increase in the total productivity of inputs on a sustained basis so that resource productivity accounts for some of the growth of total output rather than by the increase of inputs alone. Only a few countries in this century have experienced such a transformation whereby the growth rate of farm output exceeded that of total input growth for a sustained period of time. The studies of Chi-ming Hou, Anthony Tang, and Kang Chao showed that between 1952 and 1965 the rate of input growth exceeded total farm output growth so that total productivity actually declined. These measurements might be in error and predicated upon erroneous assumptions, but until other studies show the contrary and extend coverage to 1970 and after, readers will be misled by Wong's frequent assertion that an agricultural transformation followed institutional change (land reform, etc.).

The contribution of new inputs toward land and labor productivity in the future might remain negligible because production teams use their resource inefficiently, often without regard for the high opportunity costs involved, and the supply of rural labor grows more rapidly than the country's population growth rate because the state restricts migration to the cities. The modest 2.0 percent annual growth rate of output achieved between 1952 and 1970 by teams intensively using their inputs could continue for years to come with declining resource productivity. Some errors mar the text. The table on p. 263 treats land and not labor productivity.

In spite of these defects this work can be useful for readers uninformed about Chinese rural development, for it provides a good account of how the Communist Party conceived and initiated land reform over a seven-year period.

RAMON H. MYERS
University of Miami

Books for listing in this section should be sent to the Book Review Editor (see inside front cover for address).

Books Received

Boot, John C. G., *Common Globe or Global Commons: Population Regulation and Income Distribution,* Vol. 1, New York, Marcel Dekker, Inc., 1974, xi + 139 pp. $9.75.

Bowden, Elbert V., *Economics: The Science of Common Sense,* Cincinnati, South-Western Publishing Co., 1974, xiv + 703 pp. Price Unknown.

Brinkman, George, ed., *The Development of Rural America,* Manhattan, The University Press of Kansas, 1974, x + 140 pp. $8.50.

Cohen, Reuven, *The Kibbutz Settlement: Principles and Processes,* Tel-Aviv, Hakibbutz Hameuchad Publishing House Ltd., 1972, 362 pp. Price Unknown.

Coombs, Philip H., with Manzoor Ahmed, *Attacking Rural Poverty: How Nonformal Education Can Help,* Baltimore, The Johns Hopkins University Press, 1974, xvi + 292 pp. $3.95. Paper.

Ghosal, S. N., *Agricultural Financing in India,* rev. ed., Bombay, Asia Publishing House, 1972, xxiii + 227 pp. $7.50.

Hardin, Charles M., *Presidential Power and Accountability: Toward a New Constitution,* Chicago, The University of Chicago Press, 1974, vii + 257 pp. $7.95.

Howe, Charles W., *Benefit-Cost Analysis for Water System Planning,* Washington, D.C., American Geophysical Union, 1971, xii + 144 pp. $2.00. Paper.

Jallade, Jean-Pierre, *Public Expenditures on Education and Income Distribution in Colombia,* Baltimore, The Johns Hopkins University Press, 1974, xvi + 74 pp. $4.00. Paper.

Lawrie, R. A., *Meat Science,* 2nd ed., Oxford, Pergamon Press Ltd., 1974, xviii + 419 pp. $12.50. Paper.

Leftwich, Richard H., and Ansel M. Sharp, *Economics of Social Issues,* Dallas, Business Publications, Inc., 1974, xii +316 pp. $4.95. Paper.

Mäler, Karl-Göran, *Environmental Economics: A Theoretical Inquiry,* Baltimore, The Johns Hopkins University Press for Resources for the Future, Inc., 1974, x + 267 pp. $15.00.

Mincer, Jacob, *Schooling, Experience, and Earnings,* New York, Columbia University Press, 1974, xv + 152 pp. $10.00.

Montgomery, John D., *Technology and Civic Life: Making and Implementing Development Decisions,* Cambridge, The MIT Press, 1974, x + 239 pp. $12.50.

Morrissy, J. David, *Agricultural Modernization Through Production Contracting: The Role of the Fruit and Vegetable Processor in Mexico and Central America,* New York, Praeger Publishers, 1974, xv + 148 pp. $15.00.

Moss, Milton, ed., *The Measurement of Economic and Social Performance,* New York, National Bureau of Economic Research, Inc., 1973, x + 605 pp. $17.50.

Nelson, Aaron G., Warren F. Lee, William G. Murray, *Agricultural Finance,* 6th ed., Ames, The Iowa State University Press, 1973, ix + 413 pp. Price Unknown.

Patel, Arun S., *Fertiliser Use in Gujarat: A Micro-View,* Gujarat, Gujarat State Fertilizer Company Limited, 1973, vi + 141 pp. Rs. 15.

Sprague, Howard B., ed., *Grasslands of the United States: Their Economic and Ecologic Importance,* Ames, The Iowa State University Press, 1974, xii + 220 pp. $7.50.

Sweeney, Richard J., *A Macro Theory With Micro Foundations,* Cincinnati, South-Western Publishing Co., 1974, vii + 201 pp. Price Unknown.

Takeuchi, Kenji, *Tropical Hardwood Trade in the Asia-Pacific Region,* Baltimore, The Johns Hopkins University Press, 1974, xviii + 90 pp. $4.00. Paper.

Van Egmond, Dorothy, *School Foodservice,* Westport, The AVI Publishing Company, Inc., 1974, vii + 408 pp. Price Unknown.

Webb, Bryon H., Arnold H. Johnson, John A. Alford, eds., *Fundamentals of Dairy Chemistry,* 2nd ed., Westport, the AVI Publishing Company, Inc., 1974, ix + 929 pp. $39.00.

Weintraub, Andrew, Eli Schwartz, J. Richard Aronson, eds., *The Economic Growth Controversy,* New York, International Arts and Sciences Press, 1973, xv + 229 pp. $10.00.

Announcements

WINTER MEETING AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION WITH THE ALLIED SOCIAL SCIENCE ASSOCIATIONS

December 28–30, 1974
San Francisco, California

Evaluation of Econometric Models for Forecasting Within the Agricultural Sector and the Total Economy

December 28, 8:30 A.M.
(Joint session with the Econometric Society)

Chairman: R. A. SCHRIMPER, North Carolina State University

Paper: "Recent Experience with Macro Econometric Models in Forecasting Prices and Real Output"
JOEL POPKIN, Council of Economic Advisers

Paper: "Strengths and Weaknesses of Econometric Models for the Agricultural Sector"
GORDON KING, University of California, Davis

Paper: "Needed Improvements in Applications of Models for Price Forecasting of Agricultural Commodities"
WILLIAM CROMARTY, Connell Rice and Sugar Co., Inc.

Discussants: J. PHILLIP COOPER, Dynamics Associates and University of Chicago; LUTHER TWEETEN, Oklahoma State University; and HAZEN GALE, Cost of Living Council.

Structural Changes in the Food Industry: Implications for Future Public Policy

December 28, 2:00 P.M.
(American Agricultural Economics Association)

Chairman: WALTER G. HEID, JR., Economic Research Service, U. S. Department of Agriculture and Montana State University

Paper: "Impact of Changing Structure on Food Supply and Price"
FORREST E. WALTERS, Colorado State University

Paper: "Emerging Effectiveness of Competition and the Need for Consumer Protection"
DANIEL I. PADBERG, Cornell University

Paper: "Public Policy Changes Needed to Cope with Changing Structure"
DALE C. DAHL, University of Minnesota

Discussants: JAMES E. MARTIN, Virginia Polytechnic Institute and State University: and A. C. HOFFMAN, Kraft Food Company (retired)

Recent Resource Problems of Less Developed Countries

December 30, 10:30 A.M.
(Joint session with the American Economic Association)

Chairman: RONALD G. RIDKER, Resources for the Future

Paper: "Energy and Food Supplies in Less Developed Countries"
C. PETER TIMMER, Food Research Institute, Stanford University

Paper: "Changes in the Relative Bargaining Strength of the Less Developed Countries"
ERNEST STERN AND WOUTER TIMS, International Bank for Reconstruction and Development

Paper: "Domestic Adjustments and Accommodations to Higher Raw Materials and Energy Prices"
T. L. SHANKAR, Planning Commission, Government of India

Discussants: EMERY N. CASTLE, Oregon State University; and RAYMOND J. MIKESELL, University of Oregon

INTERNATIONAL LIVESTOCK CENTER FOR AFRICA

The Consultative Group on International Agricultural Research is supporting the development of an International Livestock Center for Africa. The headquarters is in Addis Ababa, Ethiopia. Associated Programs, at which staff will be located, also will be at several locations throughout tropical Africa in cooperation with national institutions.

The program emphasis will be on systems to improve livestock production, animal sciences and health, range improvement, economics and marketing, and sociology. Programs of research, documentation, education, and training will be included.

The Center is expected to be fully operational by 1977–78. Staff will include senior and associate specialists in various aspects of livestock production including the animal sciences, veterinary sciences, agronomy, range science, soil and water, economics and marketing, documentation, library services, sociology, and anthropology.

Individuals interested in the work of the Center should direct inquiries to Dr. J. R. Pagot, Director, International Livestock Center for Africa, Post Office Box 5689, Addis Ababa, Ethiopia. Applicants should be highly trained and experienced in their fields and should be able to operate in both English and French.

NOMINATING COMMITTEE FOR 1975–76 AAEA OFFICERS

The following have been appointed by AAEA President James Nielson to serve on a committee to nominate persons to fill vacancies in the offices of the Association for the year beginning August 1975:

Kenneth R. Tefertiller, Chairman
John O. Early
W. E. Hamilton
Fred K. Hines
Sylvia Lane
Daniel I. Padberg
Joseph H. Yeager.

APOLOGY

The editors regret the omission of Frederick Waugh's name from the obituaries list in the August 1974 *AJAE* Table of Contents.

1975 AAEA AWARDS PROGRAM

The Awards program of the American Agricultural Economics Association has evolved over a number of years to recognize and enhance professional excellence in several subfields of the discipline of Agricultural Economics. Nominations recognize proprofessional achievement at the student, the young professional, and the more experienced status, in research, teaching, and extension activities. In 1975, 20 awards are authorized for presentation.

The program has a rich tradition as can readily be noted by a review of the roster of award winners over the years. Your Association believes that this tradition will be continued in the excellence of the 1975 program.

The 1975 program has been organized and will be conducted by 10 committees representing a substantial professional input of nearly 100 committee members. We hope you will submit nominations for the categories outlined in this announcement. The General Awards Chairman is **Paul L. Kelley, Kansas State University.**

DISTINGUISHED EXTENSION PROGRAMS

The Distinguished Extension Programs Awards recognize achievement of excellence in extension economics teaching programs. Two awards are offered in 1975.

—One of the awards will be given to an individual who has been in extension education for less than 10 years.

—One award will be given to an extension teacher with 10 or more years of experience.

Nomination

Nominations may be made by any member(s) of the AAEA and selection will be made from among those nominated. The nominee must have been active in extension teaching within one year of the nomination, and the content of teaching efforts must be principally in the world of agricultural economics. Each nomination must be made by separate letter accompanied by *eight copies* of documentary evidence indicating:

1. nominee's name and extension title,
2. extension program area in which teaching is conducted,
3. identification of the clientele served,
4. objectives of the educational program,
5. teaching techniques, educational methods, and materials utilized, and
6. effectiveness of the extension teaching effort in terms of clientele response and/or establishment of the utility of the extension teaching program.

Evaluation

Each nomination will be evaluated on the quality of the work of the extension teacher as indicated by the documentary evidence submitted with the nomination relative to the following characteristics:

1. effectiveness of the nominee in teaching application of economic principles and tools of analysis appropriate to the problem and audience involved,
2. ability to conceptualize new extension educational programs and application of new teaching concepts to existing programs,
3. effectiveness in bringing about significant behavioral change and/or understanding of clientele, and
4. contribution to improved extension teaching in agricultural economics as evidenced by participation in appropriate professional activities and organizations.

Nominations and supporting evidence must be submitted by **February 1, 1975,** to the subcommittee chairman, **Gordon D. Rose, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota 55108.** Recommendations of the subcommittee will be forwarded to the General Awards chairman by *May 1, 1975.*

DISTINGUISHED UNDERGRADUATE TEACHING

The Distinguished Undergraduate Teaching Awards have been established to recognize and encourage meritorious performance in undergraduate teaching in agricultural economics. Two awards are given as follows:

—One for an undergraduate teacher with less than 10 years of experience.

—One for an undergraduate teacher with 10 or more years of experience.

Nomination

Nominations may be made by any member(s) of the AAEA and selection will be made from those nominated. Renominations are invited if supporting materials are brought up to date and resubmitted

1. Nominees must be actively engaged in teaching at a professional level during the 1974–75 school year.
2. Nominees must have demonstrated outstanding ability as an undergraduate teacher of agricultural economics.
3. The committee chairman will provide a standard nominating form to department heads and chairman specifying nomination procedures, number of copies of documentation evidence, etc.
4. Supporting evidence plus letters of reference from peers and students must be limited to three pages for each of five categories of evaluation listed below.

Evaluation

Five major criteria areas will be used in evaluating nominations with relative weights as follows:

1. *Quality of Teaching (45%)*
   - Ability to motivate and stimulate student to learn 20%
   - Innovation for presentation; evaluation measurements 15%
   - Mastery of subject, use and application to business conditions 10%
2. *Academic Advising, Counseling, and Extracurricular Activities of Students (20%)*
   - Advising and Counseling 14%
   - Catalyzing extracurricular activities of students 6%
     - Department clubs or organizations
     - Student Council or Senate, student publications
     - Convocations, seminars, community involvement
3. *Campus Participation in Instructional, Course, and Curricular Improvement Efforts (15%)*
   - Department
   - College
   - University-wide
4. *Professional Improvement in Teaching for Benefit of Self and Peers (15%)*
   - Published textbooks, manuals, bulletins 5%
   - Research papers related to improved teaching 5%
   - Participation in professional meetings and committees related to improved teaching and student activities 5%
5. *Department/College/University Teaching Awards (5%)*
   - Student Association/Alumni Awards

Nominations and supporting evidence must be sent by **February 1, 1975**, to the subcommittee chairman, **Russell F. McDonald, Department of Agricultural Economics and Rural Sociology, Texas A&M University, College Station, Texas 77843.** Recommendations of the subcommittee will be forwarded to the General Awards chairman by *May 1, 1975.*

OUTSTANDING MASTER'S DEGREE PROGRAMS

The Outstanding Master Degree Program awards have as their objective development of professional excellence by individuals pursuing Master's degree programs in agricultural economics. Three awards are offered. A cash supplement of $250 accompanies each award.

Nomination

1. Nominations are eligible from any department engaged in training agricultural economists at the Master's degree level.
2. An entry must be submitted by the head of the department where the degree is earned.
3. A department may submit one nomination for each 15 Master's degree candidates or fraction thereof presented to a graduate school faculty in the year. In determining the number of eligible candidates, departments should limit consideration to candidates who will receive a degree in agricultural economics and to candidates who have taken agricultural economics as a field of emphasis.
4. Nominations should include thesis or other comparable documentation.
5. Selection will be made from documentation approved in final form by the student's advisory committee during the calendar year 1974, provided the candidate has met all other formal requirements for the Master's degree.
6. A published thesis may be entered in both the published research and Master's program classes but will be eligible for only one award. Although a published thesis is acceptable, a copy of the thesis as submitted to the graduate faculty should be sent whenever possible.

Evaluation

Copies of evaluation criteria may be obtained from any member of the subcommittee.

All nominations and documentation should be sent by **February 1, 1975**, to the subcommittee chairman, **Joseph Havlicek, Jr., Department of Agricultural Economics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.** Recommendations of the subcommittee will be forwarded to the General Awards chairman by *May 1, 1975.*

OUTSTANDING DOCTORAL PROGRAMS AWARD

The Outstanding Doctoral Programs Awards are given in recognition of development of professional excellence for persons pursuing a doctoral program in agricultural economics. Three awards will be given in 1975 accompanied by a cash supplement of $250 each.

Nomination

1. An entry must be submitted by the head of the department where the thesis or comparable document was presented in partial fulfillment of requirements for a degree. A department may submit one nomination for each 12 doctoral candidates or fraction thereof presented in agricultural economics to a graduate school faculty in the year. In determining the number of eligible nominations, departments should limit consideration to candidates who received a degree in agricultural economics and to candidates who have taken agricultural economics as a field of emphasis.
2. Selection will be made from theses (or comparable documents) approved in final form by the student's advisory committee during the calendar year 1974, provided the candidate has met all other formal requirements for the doctoral degree.
3. A published thesis may be entered in both the published research and thesis categories but will be eligible for only one award. Although a published thesis is acceptable, a copy of the thesis as submitted to the graduate faculty should be sent whenever possible.
4. Three copies of a thesis must be sent to the subcommittee chairman. All copies will be returned after they have been read by the judges.

Evaluation

Criteria for evaluation of nominations may be obtained from any member of the subcommittee.

Nominations and supporting evidence should be sent by **February 1, 1975,** to the subcommittee chairman, **Kenneth D. Duft, Department of Agricultural Economics, College of Agriculture, Washington State University, Pullman, Washington 99163.** Recommendations of the subcommittee will be forwarded to the General Awards chairman by *May 1, 1975.*

PROFESSIONAL PUBLICATIONS

Four major awards are given to encourage excellence in types of publications in all areas of agricultural economics. These awards include:

—Award for Quality of Research Discovery
—Award for Quality of Communication
—Award for Publication of Enduring Quality
—Award for Outstanding Journal Article

Each award program is administered by a subcommittee. Any publication authored or co-authored by a member of a specific subcommittee will be ineligible for an award from that subcommittee.

Quality of Research Discovery and Quality of Communication

A single chairman, **Gene L. Swackhamer, Farm Credit Administration, 485 L'Enfant Plaza, S.W., Washington, D.C. 20578,** coordinates activities of two subcommittees—Quality of Research Discovery and Quality of Communications.

General Rules

1. No requirements regarding number of authors or professional experience is imposed.
2. Nominations may be by individuals, departments, or agencies.
3. Nine copies of each publication should be submitted unless expense for the individual is excessive. Return of the publications is not customary but can be requested.
4. Nominations should be submitted for only one category within which it is judged and must be so identified. A given article will be eligible for only one award in either the quality of research discovery or quality of communication category for 1974.

Quality of Research Discovery

Nomination

A maximum of two awards are given. Entries must specify that the nomination is to be judged for the quality of research discovery and must have been published in 1974.

Evaluation

The research must be a significant contribution to the field of knowledge in agricultural economics. The work should demonstrate excellence in research methodology and may deal with conceptualization of researchable problems as well as empirical verification.

Entries should be sent to the subcommittee chairman, **Gene Swackhamer,** by **February 1, 1975.** Recommendations of the subcommittee will be forwarded to the General Awards chairman by *May 1, 1975.*

Quality of Communication

Nomination

A maximum of two awards will be given. Entries must specify that the entry is to be judged for its quality of communication and must have been published in 1974.

Evaluation

Entries must demonstrate superior communication of concepts or knowledge in any subject matter area or professional specialization (i.e., research, teaching, or extension) in agricultural economics to a specified audience. If dealing with transmission of research findings the publication need not contain original research of the authors but should communicate to laymen.

Entries should be forwarded to the subcommittee chairman, **Gene Swackhamer**, by **February 1, 1975.** Recommendations of the subcommittee will be forwarded to the General Awards chairman by *May 1, 1975.*

Publication of Enduring Quality

One award is offered for a publication which has a publication date in the 15-year period 1950 through 1954. Entries are judged on the basis of the enduring quality of their contribution to the profession.

Eligible entries are articles in the *AJAE* (during the period considered, this was the *JFE*) whether or not the authors are Association members; and other publications by authors, one of whom was a member of the Association at the time of publication. Entries may be submitted by departments or other administrative units, by colleagues, or by the authors themselves. Publications receiving an award in any other category in previous years are eligible for this award.

Entries should be sent by **February 1, 1975,** to the subcommittee chairman, **Earl R. Swanson, Department of Agricultural Economics, University of Illinois, Urbana, Illinois 61801.** If the publication is not readily available, nine copies should be sent. Entries will be forwarded to the General Awards chairman by *May 1, 1975.*

Outstanding Journal Article

The editors and editorial council of the *American Journal of Agricultural Economics*, with the editor as chairman, will choose the most outstanding article in the 1974 volume of the *Journal.*

FELLOW OF THE AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION

Nominations to be considered for election as Fellow of the Association should be sent to the Secretary-Treasurer, **John Redman,** by **December 1, 1974.** Documentation is needed to support the nomination. Selection is made by a committee of Fellows.

BROWNING AWARD

Details of the selection process will be noted in a separate brochure to be mailed to department chairmen. Chairman of this subcommittee is **Nathan M. Koffsky, International Bank for Reconstruction and Development, Washington, D.C.**

GENERAL RECOGNITION

Recipients of awards will be presented at the Annual Awards Program of the Association at the annual meeting in Ohio in August 1975. Winners for all categories noted above will be identified in the annual meeting awards program brochure and in the Proceedings issue of the *American Journal of Agricultural Economics.*

News Notes

THE AGRICULTURAL DEVELOPMENT COUNCIL, INC.

Appointments: **William L. Collier,** as an associate, to continue work with the Agro-Economic Survey in Indonesia; **Robert E. Evenson,** formerly associate professor at the Economic Growth Center of Yale University, as an associate, to work at the University of the Philippines at Los Banos; **Ralph H. Retzlaff,** formerly associate professor of political science at the University of California, Berkeley, as Director of the Asia Office in Singapore, to direct the Council's Interregional Program for Asian social scientists.

Leave: **Raymond E. Borton,** from the Philippines to the Food Research Institute, Stanford University, on sabbatical leave.

Reassignment: **Donald C. Taylor,** from Bogor, Indonesia, to Kuala Lumpur as Associate for Malaysia.

Resignation: **Bryant E. Kearl,** from the Directorship of the Asia Office to the Department of Agricultural Journalism, University of Wisconsin, Madison.

THE UNIVERSITY OF ARIZONA

Return: **John Fischer,** as professor after more than two years in Turkey under a U.S. AID-Arizona agreement.

AUBURN UNIVERSITY

Appointment: **John L. Adrian,** Ph.D. Tennessee, as assistant professor.

UNIVERSITY OF CALIFORNIA, DAVIS

Appointments: **Richard D. Green,** Montana State University, visiting professor for Spring Quarter 1974; **John E. Kushman,** University of North Carolina, acting assistant professor.

Leaves: **Harold O. Carter,** granted leave from department chairmanship January 1, 1974, to June 30, 1974, to serve as chairman of a Division of Agricultural Sciences' Food and Fiber Task Force; **Quirino Paris,** to University of Calabria, Cosenza, Italy, as visiting professor, March through September 1974; **Gordon C. Rausser,** to University of Chicago as visiting professor, January through May 1974.

CLEMSON UNIVERSITY

Appointment: **J. Edwin Faris,** former chairman of the department at Washington State University, as Professor and Head, Department of Agricultural Economics and Rural Sociology, effective October 1, 1974.

COLORADO STATE UNIVERSITY

Appointments: **Dwight Blood,** Ph.D. Michigan, as visiting professor in economics; **Harold C. Cochrane,** Ph.D. Colorado, as temporary instructor of economics; **Warren Trock,** Ph.D. Montana State, as special professor.

Leaves: **Henry H. Biggs,** to serve as development economist for the Development and Resource Corporation of Sacramento, California, working with Iran's Ministry of Water and Power in formulating a national water plan, March 1975 to January 1976; **Ronald A. Wykstra,** to serve as economic adviser to the government of Western Samoa, working with the economic development department in monetary and fiscal policy, international trade and investment, and development planning, September 1974 to September 1975.

Retirement: **Henry H. Hudek,** in June 1974 after 20 years with the department.

CORNELL UNIVERSITY

Leaves: **Max E. Brunk,** sabbatical, for one month with Thomas Borthwick and Sons, Ltd., Australia and five months with the Farmer's Cooperative Service, Washington, D.C.; **R. Brian How,** one year sabbatical with the Economics Division, Canada Department of Agriculture, Ottawa.

Reassignment: **James J. Jacobs,** research associate, to become resource economist with ERS, USDA at Cornell.

Retirements: **Lawrence B. Darrah** after 30 years of service; **Glenn W. Hedlund** after 32 years of service.

UNIVERSITY OF FLORIDA

Appointments: **Kenneth C. Clayton,** formerly research assistant at Purdue, as assistant professor in land use economics; **Lawrence A. Halsey,** MAMRD Florida, as area farm management economist to work in Belle Glade, Florida; **J. Dean Jansma,** associate professor at Pennsylvania State, as visiting professor September 1974 through June 1975; **Clyde F. Kiker,** formerly assistant professor at the University of Kentucky, as assistant professor in environmental economics; **Ernest B. Smith,** formerly research associate at Mississippi State, as agricultural economist, Commodity Economics Division, ERS, USDA.

UNIVERSITY OF ILLINOIS

Appointments: **C. Robert Taylor,** assistant professor; **Donald L. Uchtmann,** assistant professor.

Leaves: **R. P. Kesler,** sabbatical for one year ending August 20, 1975; **A. G. Mueller,** sabbatical for six months ending December 31, 1974; **R. G. F. Spitze**, sabbatical for one year ending August 20, 1975; **T. Takayama**, sabbatical for six months ending June 30, 1975.

IOWA STATE UNIVERSITY

APPOINTMENTS: **William M. Edwards**, as instructor in economics; **Wallace E. Huffman**, as assistant professor in economics; **Carl W. O'Connor**, as assistant professor in economics; **John A. Otte**, as instructor and associate in economics; **Gordon C. Rausser**, as professor in economics.

HONOR: **Earl O. Heady**, professor of economics, has been selected to receive the Gamma Sigma Delta International Award for Distinguished Service to Agriculture for 1974.

RESIGNATION: **Erik Thorbecke**, professor, to accept position as professor of economics at Cornell University.

THE UNIVERSITY OF MANITOBA

RETURN: **Martin H. Yeh**, associate professor, after a two-year leave with the United Nations Economic Commission for Latin America in Santiago, Chile.

UNIVERSITY OF MARYLAND

LEAVE: **Phillips Foster**, professor, for nine months' sabbatical beginning November 1, 1974; he will be at the Department of Agricultural Economics, University of New England, Armidale, N.S.W., Australia.

UNIVERSITY OF MASSACHUSETTS

APPOINTMENT: **George R. McDowell**, as professor in agricultural and food economics.

MICHIGAN STATE UNIVERSITY

APPOINTMENTS: **Kwanchai** and **Arturo Gomez** from the Philippines will be visiting professors for academic year 1974–75; **Susumu Hondai**, Ph.D. candidate, as research associate for one year; **Ahkter A. Khan**, visiting professor for Winter Quarter 1975; **John McKeon**, Ph.D. candidate, research associate for three months; **James Shaffer**, named Director for the Center for Rural Manpower and Public Affairs; **James Trapp**, Ph.D. candidate, research associate for two years.

LEAVE: **Garland Wood**, for two years effective August 1, 1974, to work with the Ford Foundation in Pakistan.

MISSISSIPPI STATE UNIVERSITY

RESIGNATION: **Thomas H. Foster**, assistant professor, to join the Tennessee Valley Authority's International Fertilizer Marketing staff at Muscle Shoals, Alabama.

RETIREMENT: **L. Dow Welch**, assistant professor, in June 1974 after 20 years service with the university.

NEW MEXICO STATE UNIVERSITY

APPOINTMENT: **Garrey E. Carruthers**, associate professor of agricultural economics and agricultural business, as one of the 1974–75 White House Fellows, beginning September 1974; **Thomas H. Stevens**, formerly senior research associate at Cornell, as assistant professor of resource economics.

NORTH CAROLINA STATE UNIVERSITY

APPOINTMENTS: **Thomas Johnson**, as associate professor of economics and statistics; **R. James Peeler, Jr.**, Acting Dean of the Graduate School.

LEAVE: **Fred A. Mangum, Jr.**, associate professor, to work with the Michigan State project in Korea.

RETIREMENT: **Ernest M. Stallings**, Extension assistant professor, effective June 30, 1974.

NORTH DAKOTA STATE UNIVERSITY

APPOINTMENT: **Donald F. Scott**, Ph.D. Missouri, as assistant professor in natural resource economics.

RESIGNATION: **Ronald G. Fraase**, assistant professor, to accept appointment as marketing specialist with the North Dakota State Wheat Commission, effective April 1, 1974.

OHIO STATE UNIVERSITY

APPOINTMENT: **Lynn Forster**, Ph.D. Michigan State, as assistant professor in the farm management area.

OKLAHOMA STATE UNIVERSITY

APPOINTMENT: **Harry P. Mapp**, formerly assistant professor at Cornell, as associate professor in farm management and production economics.

REASSIGNMENTS: The Commodity Economics Division of ERS is establishing a data system to develop and maintain enterprise budgets for all major farm commodities and production regions in the U. S. The system is a cooperative project with Oklahoma State and will be located in Stillwater. The system utilizes the Oklahoma Budget Generator developed by **Darrel Kletke**, who will be associated with the project. ERS personnel will include **Ronald D. Krenz**, Project Leader, **Charles Micheel**, and **Gail Garst**.

OREGON STATE UNIVERSITY

APPOINTMENTS: **Frederick W. Obermiller**, assistant professor and Extension Community Resource Development Specialist; **Bruce A. Weber**, Ph.D. Wisconsin, assistant professor and Extension Community Resource Development Specialist.

THE PENNSYLVANIA STATE UNIVERSITY

APPOINTMENT: **Blair J. Smith**, formerly with the University of Georgia, as associate professor.

RETIREMENT: **C. William Pierce**, Professor Emeritus, after 37 years with the university.

PURDUE UNIVERSITY

AWARD: **Donald R. Schwartz** received the American Institute of Cooperation's $1,000 Nourse Award for distinguished and scholarly research as a Ph.D. candidate on a subject relevant to U. S. agricultural cooperatives. The title of his dissertation at Purdue is, "Vertical Coordination in Cooperative Grain Marketing Systems," and the objective of his study was to determine ways to improve the cooperative system of marketing grain.

RETURNS: **Karl W. Kepner**, associate professor, after one year at Washington University and Creative Management Institute, St. Louis, Missouri; **Wilford H. M. Morris**, professor, after one year with U.S. AID, African Bureau, West Africa; **Robert C. Suter**, professor, after one year with Northwestern University Law School and Harris Trust and Savings Bank, Chicago.

STATISTICAL REPORTING SERVICE, USDA

RETIREMENT: **J. Richard Grant**, USDA Statistical Clearance Officer and Assistant Director of Research Division, effective June 1974 after 39 years of service.

UNIVERSITY OF TENNESSEE

APPOINTMENT: **Thomas H. Klindt**, assistant professor.

TEXAS TECH UNIVERSITY

AWARDS: **Hong Y. Lee**, associate professor, was named the Outstanding Teacher of the Year in the College of Agricultural Sciences for 1973–74; **Sujit K. Roy**, associate professor, received one of three Distinguished Teaching Awards in the University for 1973–74, an award sponsored by Amoco Foundation, Inc., and including a $1,000 grant.

UNIVERSITY OF VERMONT

APPOINTMENT: **Arthur H. Smith**, Ph.D. Arizona, as assistant professor and assistant agricultural economist in resource economics.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

APPOINTMENTS: **William T. Boehm**, Ph.D. Purdue, as assistant professor; **Dilip C. Pendse**, formerly at Oregon State, as research associate; **Dennis Smith**, from the University of Delaware, as visiting assistant professor.

UNIVERSITY OF WISCONSIN

APPOINTMENTS: **Bruce Marion**, formerly professor of agricultural economics at Ohio State, to become Executive Director of NC 117 "Organization and Control of the U. S. Food Production and Distribution System," beginning September 1, 1974; **Ronald A. Oliveira**, Ph.D. California-Davis, as assistant professor in forestry.

OTHER APPOINTMENTS

William J. Dahl, Ph.D. Purdue, Mitre Corporation.

Darrell Lynn Gerke, M.S. Purdue, Assistant to the President, Conestoga Transportation Co., Lancaster, Pennsylvania.

Glen E. Goad, M.S. Virginia Polytechnic, Kroger Company.

Foo-Shiung Ho, Ph.D. Virginia Polytechnic, Chicago Board of Trade.

James A. Lewis, Ph.D. Virginia Polytechnic, to Environmental Economics Branch, ERS, USDA.

Clarence J. Miller has a one-year assignment in Tanzania with a Louis Berger International team.

James Edward Pratt, M.S. Purdue, to Kalamazoo, Michigan.

Abdullah Ahmad Saleh, Ph.D. Purdue, agricultural economist, Foreign Agricultural Service, USDA, Washington, D.C.

Donald Richard Schwartz, Ph.D. Purdue, staff economist, Chicago Board of Trade.

Royce Stratton, M.S. Arkansas, Federal Land Bank, St. Louis, Missouri.

David Zimet, M.S.A. Florida, U.S. AID Economic Adviser to the Ministry of Agriculture, San Salvador, El Salvador.

OBITUARIES

Clarence C. Bowen, 64, associate professor, Emeritus at Ohio State University, died May 4, 1974.

Professor Bowen was a native of Montpelier, Ohio, and received both his B. S. and M. S. degrees from Ohio State University. In early years he was a teacher of vocational agriculture and a technician with the Western Ohio Breeders Association. In 1943 he accepted a position as County Agriculture Agent in Preble County, Eaton, Ohio. He held this position until 1959 at which time he became a member of the faculty of the Department of Agricultural Economics and Rural Sociology at Ohio State University as a livestock marketing specialist, a position he held until retirement.

During the period of his association with the university, one of Bowen's most significant contributions was the development, demonstration, and evaluation of carcass weight selling of beef and hogs in Ohio. He worked closely with Ohio meat packers and livestock market operators and was an author of the Cooperative Extension Service bulletin, "Auction Selling of Slaughtered Cattle on a Carcass Basis—An Alternative Approach." This publication had a major impact in Ohio and was reprinted because of wide demand throughout the U. S. Bowen was an agent of change in the livestock industry in Ohio, and because of his work there has been a large increase in the proportion of Ohio beef and hogs sold on a weight and carcass grade basis. Members of the livestock marketing industry as well as consumers are beneficiaries of his work. In 1967 he served three months as a consultant to the Brazilian Government in developing a meat-type hog production and marketing program for Brazil.

He is survived by his wife, Ocena, one daughter, one son, one sister, and one brother.

James C. Snyder, 44, professor of agricultural economics at Purdue University, died June 1, 1974, of a massive heart attack.

Professor Snyder was born and raised in Ontario, Canada. He earned his bachelor's degree at Ontario Agricultural College in 1953, M. S. degree in 1956 at Purdue, and Ph.D. in 1962 at Purdue. In recognition of his excellence in research, he received a Ph.D. thesis award from the American Farm Economic Association, the first such award earned at Purdue.

Upon completion of graduate study, Snyder became a member of the faculty in agricultural economics at Purdue and began a brilliant teaching and research career, attaining the rank of professor in 1969. He was named Teacher of the Year in recognition of his outstanding undergraduate instruction in business management. He also taught at Goshen College, where he was especially esteemed for his business policy courses.

Snyder's pioneering research contributed greatly to knowledge about the practical applicability of quantitative approaches to decision making in the management of agribusiness firms. He was particularly gratified by his successful development of a compacted matrix approach, which enabled large and complex computer problems to be solved relatively quickly and easily. He knew the supreme satisfaction which comes to the scholar whose efforts have produced excellence that truly serves and benefits others.

Professor Snyder was a master teacher of graduate students. He gave personalized and rigorous training, made research exciting, and students responded with hard work, devotion, and admiration. We shall all remember a brilliant colleague who, in his few years, gave so much. He was married in 1962 to Mary Ruth, daughter of Professor Emeritus Noah S. Hadley. The Snyders were the parents of four children.

ADDENDUM

Doctoral Degrees in Agricultural Economics Conferred in 1973, by Subject Area

XI. HUMAN RESOURCE DEVELOPMENT

Andrew Wangdali Bacdayan, B.S. University of the Philippines, 1959; M.S. Michigan State University, 1962; Ph.D. Utah State University, *The Supply of Public School Teachers in the U.S.: A Study in Human Capital Theory.*

XIV. NATURAL RESOURCE ECONOMICS

John E. Keith, B.S. Utah State University, 1967; M.S. Utah State University, 1969; Ph.D. Utah State University, *The Economic Efficiency of Inter-Basin Transfers of Agricultural Water in Utah: A Mathematical Programming Approach.*

XVII. REGIONAL ECONOMICS

Archie Allen Dyer, B.S. University of California, 1962; M.S. Utah State University, 1968; Ph.D. Utah State University, *Timber Harvesting and Regional Income Distribution.*

Nureddin Taqieddin, B.S. American University of Beirut, 1962; M.S. Utah State University, 1968; Ph.D. Utah State University, *Evaluation of the Impact of Federal Participation on the Distribution of Economic Activity and Population in the State of Utah.*

Thomas Larry Williams, B.S. Utah State University, 1964; M.S. Utah State University, 1966; Ph.D. Utah State University, *Transportation and Public Service Costs for Rural Communities of Various Sizes.*

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The Rise of the Mixed-Tenure Farm; An Examination of Official Statistics .... *N. B. Hill*

A Note on Distributed Lag Models of Maize and Wheat Production: The Kenyan Case . . *J. K. Maitha*

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Reviews, etc.

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VOLUME 4, NUMBER 1 SPRING 1974

An Urban-Regional Employment Demand Model .... *Michael Babcock*

Development of an Economic-Environmental Trade-Off Model for Industrial Land-Use Planning .... *R. M. Davis, G. S. Stacey, G. I. Nehman, and F. K. Goodman*

City-Suburb Variations in Housing Consumption and Production Patterns ....*Randolph C. Martin*

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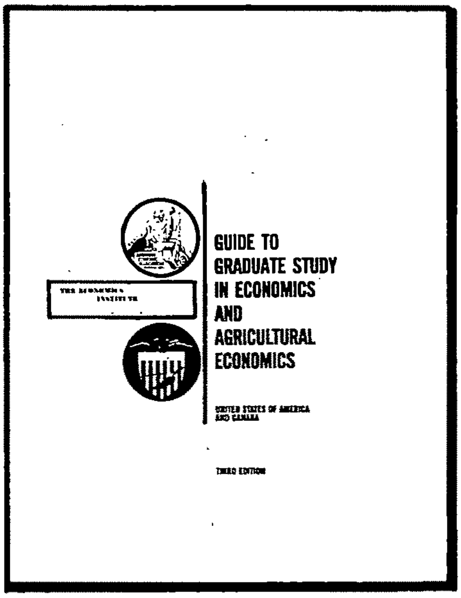

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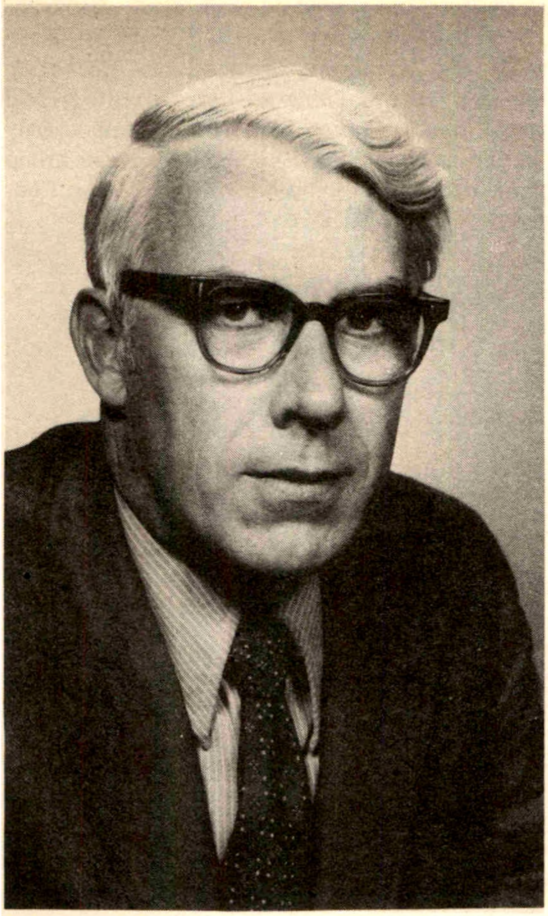


1974 AAEA FELLOW

Dale E. Hathaway

Senior Program Advisor, Ford Foundation, 1973
Chairman, Department of Agricultural Economics, Michigan State University, 1969–1973
Professor, Department of Agricultural Economics, Michigan State University, 1948–1973
President, AAEA, 1969–70; Vice President, AFEA, 1962–63
Senior Staff Economist, President's Council of Economic Advisers, 1955–56
Author, Government and Agriculture, *1963;* The Problems of Progress in The Agricultural Economy, *1964; Coauthor of* The People of Rural America, *1968*

Dale E. Hathaway has won international acclaim as a scholar and student of the economics of agriculture. His acute insight into the practical world of public policy decision making gives his work a unique dimension most particularly in its skillful integration of both economic and political variables. Highly valued for his penetratingly critical mind, always vigorously applied, he has served with distinction as an economist and policy analyst not only in the University but in government and with foundations and has been widely sought as a consultant. An outstanding teacher, who effectively uses the Socratic method, he has challenged and inspired students of agricultural policy for more than two decades.

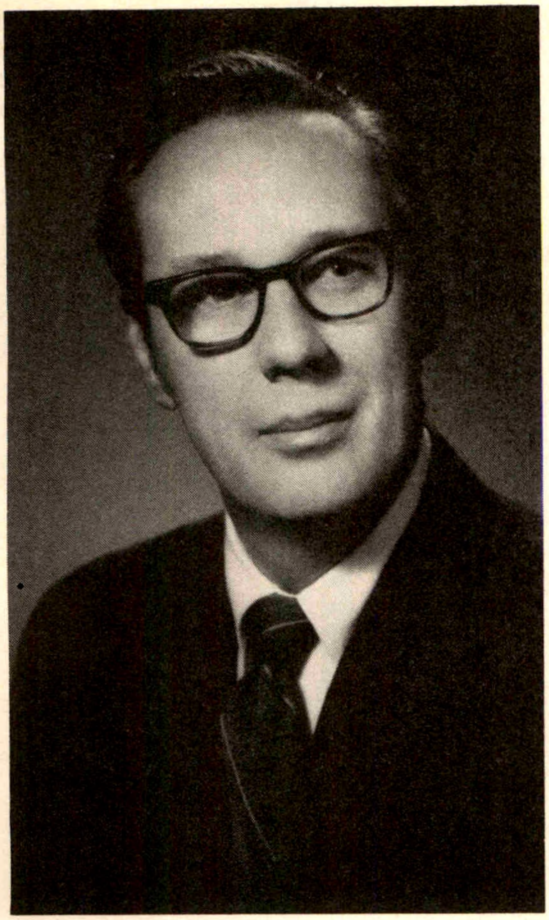
Following receipt of his B.A. in 1947 and M.A. in 1948, both in economics, Dr. Hathaway became an extension specialist in public affairs at Michigan State University. In 1952 he was awarded his Doctorate in Public Administration from Harvard University. Returning to Michigan State University, he began a broad and varied career that was to include major contributions in commercial agricultural policy, international trade, foreign economic development, monetary and business cycle analysis of the agricultural sector, rural manpower and farm labor policy, and demographic and migration analyses.

He has served his University well and in many capacities. He directed the graduate program in the Department of Agricultural Economics from 1962 to 1969, when he became Chairman of the Department. He also served in 1959 as Chairman of the Committee on the Future of the University, during 1968–1970 as Chairman of the Steering Committee of the Faculty, and in 1969 as Chairman of the Search and Selection Committee that obtained a new President for the University. He served our Association as President in 1969–1970.

Dr. Hathaway took leave from the University to serve as a Senior Staff Economist for the

President's Council of Economic Advisers in 1955–1956. He also was a Visiting Professor at the University of Chicago in 1961–1962, where he finished work on his widely used and influential volume, *Government and Agriculture: Economic Policy in a Democratic Society.*

In 1954 he won the AFEA award for the best journal article in the JFE. In 1956 and again in 1958 and 1967 he received the AFEA award for best published research. He coauthored in 1968 the first systematic study of the impact of the European Economic Community on European agriculture and the world grain trade. As Senior Program Advisor at the Ford Foundation since 1973, Dr. Hathaway has used his insights to improve understanding of the current critical world food situation. He is now temporarily serving on the staff of the United Nations group planning the November 1974 World Food Conference.



1974 AAEA FELLOW

VERNON W. RUTTAN

President, Agricultural Development Council, 1973–

Director, Economic Development Center, University of Minnesota, 1970–1973

Head, Department of Agricultural and Applied Economics, University of Minnesota, 1965–1970

Staff Economist, Council of Economic Advisers, 1961–1963

President, AAEA, 1971; Vice President, AFEA, 1967

Author, Economic Demand for Irrigated Acreage; *Coauthor,* Agricultural Development: An International Perspective; *Co-editor,* Agricultural Policy for an Affluent Society

VERNON W. RUTTAN has made major contributions to the literature in agricultural economics and economics over a broad spectrum of subject matter, but it is his published works on the economics of technical change, generally, and on the induced innovation hypothesis, particularly, which have won him international acclaim.

A native of Michigan, Dr. Ruttan attended Michigan State University and received his B.A. degree from Yale in 1948. He was awarded his M.A. and Ph.D. degrees from the University of Chicago, the latter in 1952. His strong training and solid theoretical base in economics coupled with a keen interest in agricultural and other applied economics fields help explain the hybrid vigor of his research. This union of theory with relevant empirical applications is reflected both in his own work and in that of the students and colleagues with whom he has worked directly or otherwise influenced.

Prior to his appointment as President of the Agricultural Development Council in 1973, Dr. Ruttan served ably in a number of professional assignments: as an economist with the Tennessee Valley Authority, 1951–1954; on the faculty at Purdue University, 1955–1963; with the International Rice Research Institute, 1963–1965; and with the University of Minnesota, as Head of the Department of Agricultural and Applied Economics, 1965–1970, and as Director of the Economic Development Center, 1970–1973. While on leave from Purdue University he served as a staff economist with the President's Council of Economic Advisers, 1961–1963, and as an economist at the University of California at Berkeley, 1958–1959.

Dr. Ruttan is known as a stimulating lecturer and a prolific and stimulating writer. On five occasions—1956, 1957, 1962, 1966, and 1967—the American Agricultural Economics Association presented him with awards for his outstanding published works. He is the author of *Economic*

Demand for Irrigated Acreage, coauthor of *Agricultural Development: An International Perspective*, and co-editor of *Agricultural Policy for an Affluent Society*. A contributor of numerous articles in scholarly journals, books, and bulletins, he also writes and lectures effectively on a popular, nontechnical plane.

His professional contributions have had an international impact. In addition to his extensive writing and lecturing, he has served as adviser to a large number of graduate students, both foreign and domestic. He has also served in an advisory capacity to numerous agencies and institutions such as AID, ADC, Economics Institute, and SEADAG. While many of his involvements in agricultural development have had an Asian focus, he has made significant contributions in other developing countries as well.

He was President of AAEA in 1971–1972 and Vice President in 1967–1968. He has also served on several key Association committees and on the editorial council of the Association's Journal.

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1974 AAEA FELLOW

John F. Timmons

Fellow, American Association for the Advancement of Science
Fellow, Soil Conservation Society of America
Former Chairman, National Committee on Soil and Water Use
Director, Iowa State USAID/Peru Program, 1962–
Co-editor, Land Problems and Policies *and* Iowa's Water Resources

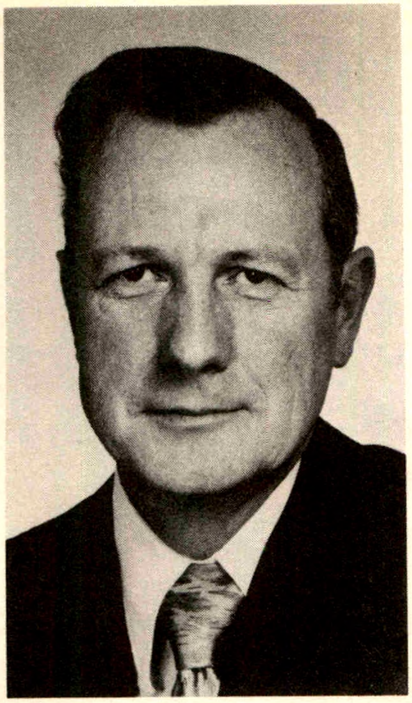
John F. Timmons has led the way for the past 30 years in the application of modern economic tools to problems of land tenure systems and soil and water policy. In recent years his pioneering work in the study of the relationship of land tenure systems to economic growth in underdeveloped countries has provided new insights for both researchers and planners. He was responsible for initiating the Iowa State USAID economic development program in Peru and has directed it since its inception in 1962.

Born in 1912 in Missouri, Dr. Timmons received B.S. and M.A. degrees from the University of Missouri. He took his Ph.D. at the University of Wisconsin in 1945 under the influence of a great tradition in land economics research established there by Henry C. Taylor and Benjamin H. Hibbard.

Endowed with a keen mind and uncommon ability and trained by eminent mentors, Dr. Timmons made impressive contributions even during the fledgling years of his career. Having gained a reputation as an outstanding land economist in the nine years he spent in the U. S. Bureau of Agricultural Economics, he joined the Iowa State University faculty as a full professor at age 34.

Dr. Timmons is a Fellow of the American Association for the Advancement of Science and a Fellow of the Soil Conservation Society of America. He is a past Vice President of the American Agricultural Economics Association. In addition, Dr. Timmons has served on numerous national and regional committees of a professional nature. He has served as chairman of the National Committee on Soil and Water Use of the National Academy of Science and has been a consultant to the Inter-American Institute of Agricultural Sciences, Organization of American States.

Dr. Timmons is co-editor of *Land Problems* *nd Policies* and *Iowa's Water Resources* and is he author of countless bulletins and articles. ot only through his writings but also through is teaching, he has had great impact both in his country and abroad. More than a hundred tudents have completed graduate degrees under is direction. Many of his former graduate stu-ents now occupy positions of leadership in niversities across the United States and in gencies of the federal government. Through students who have studied with him, his guiding hand is present in at least a dozen foreign countries, most notably in Peru where a substantial number of students trained and inspired by him during the past decade are now actively engaged in programs to implement the country's economic development. Although his major teaching activity has been at the graduate level, Dr. Timmons has taught with no less skill and enthusiasm at the undergraduate level.



PRESIDENT

AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION 1974–1975

JAMES NIELSON

Director of Research, College of Agriculture, Washington State University
Former Chairman, Department of Agricultural Economics, Washington State University
Past President, Western Agricultural Economics Association
Vice President, AFEA, 1967–68
Editor, JFE, *1962–65*

JAMES NIELSON grew up on a livestock-wheat farm in Kansas. His bachelor's degree is from Kansas State University; he received a Carnegie Fellowship for graduate study at Harvard University where he was awarded his master's and Ph.D. degrees.

In addition to four years service in the U. S. Army during World War II, Dr. Nielson's work experience includes two years as an associate county agricultural agent with the Kansas Extension Service. From 1951 to 1965 he did extension, teaching, and research in the Department of Agricultural Economics at Michigan State University. His extension work was in the area of farm management. His teaching was in farm management, production economics, and managerial concepts. His major research areas were farm practice adoption, evaluation of an extension experiment, use of capital and credit in agriculture, managerial processes, and managerial performance.

In 1965 Dr. Nielson was appointed chairman of the Department of Agricultural Economics at Washington State University, and in 1971 he was named Director of Research in the College of Agriculture at that institution.

He has served as a member of the Governor's Economic Advisory Council since 1969, as a consultant to other agencies of state government, and as a member of the Joint Scientific Committee for the state Water Research Center.

Dr. Nielson was President of the Western Agricultural Economics Association, 1968–1969, Chairman of the Western Agricultural Economics Research Council in 1970, and is now Chairman-elect of the Western Association of Agricultural Experiment Station Directors. He is a member of the National Universities Council on Water Research. He is a member of the Experiment Station Committee on Organization and Policy of the National Association of State Universities and Land-Grant Colleges, and is chairman or member of the Marketing, Rural Development, Legislative, and Federal Fund Accountability Subcommittees.

Dr. Nielson has served as chairman or member of a number of AAEA committees including Student Activities, Education, and Professional Activities. He was editor of the *Journal of Farm Economics*, 1962–1965, and Vice President of the AFEA in 1967–1968.

PRESIDENTIAL ADDRESS

Accountability and Innovation: Challenges for Agricultural Economists*

JAMES NIELSON

THE 1960s might be called a Golden Era in the support of public programs in teaching, extension, and research in the U. S. The scene shifted dramatically with the arrival of the 1970s, and support became harder to get.

I will discuss briefly some of the major reasons for the shift in support. The paper will focus on obtaining future support for the kinds of programs that agricultural economists conduct. The discussion will emphasize accountability, because I believe accountability will largely determine how much support agricultural economics or any other discipline will obtain in the years ahead. I will *not* be concentrating on administrative problems; I am convinced that accountability is a problem for every member of this profession.

A secondary theme of the paper is the need for agricultural economists to be more daring, more innovative. Among other things, accountability involves using funds for valuable, productive purposes; doing so requires innovation.

Changes in Support

The 1960s

As college enrollments doubled in the 1960s and costs per student increased, state and federal support for higher education rose substantially. The 1960s also brought large increases in support for research and development (R&D).

Public support for agricultural research more than doubled during the 1960s. Private industry also made large increases in its investments in agricultural R&D during this period.

Cooperative Extension Service's contribution to increases in agricultural production and marketing efficiency and in human and community resource development were recognized. Funds for extension (federal, state, and local) more than doubled from 1960 to 1970.

The 1970s

Since the early 1970s it has become harder to get increases in support for teaching, research, and extension, and in some cases, even to maintain support at existing levels. One of the biggest deterrents to funding increases is the contemporary performance of our economic system. In particular, the trouble we are having with inflation is causing major funding problems for public institutions.

Inflation hits public institutions three ways. First, it increases the costs of services and goods they must buy to carry out their activities. Second, inflation makes the competition for public funds more intense, because costs of other agencies are similarly affected. Third, the financial squeeze on taxpayers leads them to urge legislators to cut taxes.

The second big reason for a leveling off in support has been the loss of public confidence, especially loss of confidence in government and universities. Higher education—especially in the four-year institutions—lost legitimacy with some students, legislators, and the public. This loss and general budgetary pressures caused many state legislatures to cut back their rate of increase in appropriations to four-year institutions.

The slowdown in the rates of increase in enrollments in the 1970s lessened the support for higher education. Federal grant support of universities also declined, with an especially sharp impact on graduate programs.

Increasing costs of education and the loss of confidence in four-year colleges have motivated parents and students to seek alternatives to conventional higher education. During the past five to ten years, an increasing percentage of high school graduates who have gone to college have chosen community colleges, or vocational or

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* The author appreciates the insightful review comments and other help in preparing the paper received from J. Edwin Faris, Paul W. Barkley, Walter R. Butcher, A. H. Harrington, Ralph A. Loomis, Myron E. Wirth, M. T. Buchanan, and J. M. Roop. Special thanks are due Roland R. Robinson, John R. Myers, and Philip L. Dopkowski of the Cooperative State Research Service, USDA, for help in obtaining some of the data.

JAMES NIELSON *is Director of Research, College of Agriculture, Washington State University.*

trade schools. The Department of Health, Education and Welfare projects enrollments in two-year institutions to grow three times as fast as enrollments in four-year institutions from 1971 to 1981 [15].

The decline in public confidence in science and technology has been especially acute. An important reason for the loss of confidence and decline in support for R&D is a feeling that it really has not solved some of the fundamental problems of our society. Such problems include achieving population size consistent with our resource base, protecting the quality of our environment, and solving the problems of depopulated rural areas and congested cities.

To compound the problem of maintaining support for public institutions, society's goals appear to be changing. Less emphasis is being put on such goals as production, growth, efficiency, and income. More emphasis is being placed on goals such as stability, equity, environment, recreation, and quality of life. In addition, it has increasingly dawned on some people that production technology sometimes produces undesirable side effects in areas of current national concern.

Agricultural research and extension have by no means escaped public criticism. We are credited with helping bring about increasing agricultural output and productivity. But we are also credited with contributing to burdensome farm surpluses of the 1950s and 1960s, of giving too little attention to consumers, and to the impacts of agricultural technology on farm workers, low income rural people, and declining rural communities.

Support for Agricultural Economics Work

Let us now discuss support for agricultural economics teaching, research, and extension in more detail.

Support for agricultural economics teaching

Support for teaching programs has been fairly closely related to measures of teaching load, such as number of students or student credit hours taught. As undergraduate enrollments in colleges of agriculture rose, undergraduate enrollments in agricultural business and economics increased from 2,668 in 1962 to 4,641 in 1967, where it remained essentially constant [10].

Agricultural economics has consistently had the highest numbers and the largest percentages of graduate student enrollees in colleges of agriculture. But, while enrollments in other disciplines in agriculture are increasing, ours have been declining—by 10 percent between 1967 and 1973 (Table 1).

Table 1. Graduate enrollment in agricultural economics, total number and as percentage of graduate enrollments in colleges of agriculture, 1967–73

	Agricultural Economics Graduate Enrollments[a]	
	Total no.	Percent
1967	2276	14.0
1968	2136	13.6
1969	2234	13.9
1970	2124	12.7
1971	2053	12.6
1972	2068	11.4
1973	2013	11.4

Source: [10].

[a] Fall term enrollments for member institutions of NASULGC.

I could not uncover data on numbers of teachers or teaching budgets in agricultural economics, but the figures must be substantial. Some of this support may be vulnerable to reallocation to other departments if the agricultural economics share of enrollments continues to decline.

Support for agricultural economics research

Data were obtained on funds and scientist years (SY) allocated to state agricultural experiment station (SAES) agricultural economics research, USDA agricultural economics research, and total agricultural research for fiscal years 1967 to 1973 (Table 2). Funds from federal appropriations, state sources, and grants are included.[1]

The table shows dollars and scientist years devoted to research classified under the science category, Economics, and for all agricultural research, including Economics. Scientist years refer to professional scientist inputs used each year. Such support help as scientific aides, technicians, clerks, and secretaries is not included. The dollar figures include support help and operational funds. The USDA Economics column primarily refers to the Economic Research Service (ERS), but includes economics research con-

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[1] It should be noted, however, that the accounting for grant funds is incomplete because of agency and station reporting procedures.

Table 2. **Funds and scientist years for research, agricultural economics and total, U. S. Department of Agriculture and state agricultural experiment stations, 1967–73**

	USDA				SAES[a]				Total			
	Economics[b]		Total		Economics		Total		Economics		Agricultural Research	
Fiscal Year	Dollars (000)	SY	Dollars (000)	SY	Dollars (000)	SY	Dollars (000)	SY	Dollars (000)	SY	Dollars (000)	SY
1967	16,892	542.7	188,348	4343.4	16,521	440.9	284,584	5827.8	33,413	983.6	472,932	10,171.2
1968	16,757	541.7	193,216	4349.7	15,159	472.1	272,196	5812.8	31,916	1013.8	465,412	10,162.5
1969	17,179	529.9	199,843	4356.3	16,246	482.8	297,464	6060.6	33,425	1012.7	497,307	10,416.9
1970	16,870	540.3	217,024	4395.4	17,901	502.9	319,595	6144.2	34,771	1043.2	536,619	10,539.6
1971	21,221	551.5	240,591	4397.7	21,201	501.9	342,786	5981.1	42,422	1053.4	583,377	10,378.8
1972	22,378	569.1	264,122	4476.3	22,268	517.1	362,991	6058.4	44,646	1086.2	627,113	10,534.7
1973	25,585	559.1	296,272	4558.0	22,826	529.1	395,067	6125.1	48,511	1088.2	691,339	10,683.1

Source: [11].

[a] Includes forestry schools and other cooperating institutions (the latter primarily the Colleges of 1890).

[b] Includes all USDA agencies in which economics research is conducted.

ducted by all Departmental agencies. The SAES column is primarily research in the state agricultural experiment stations. But it includes economics research in forestry schools and in other cooperating institutions, the latter being primarily the Colleges of 1890.

Table 2 shows that support for agricultural economics research, both in the USDA and at the colleges and universities, grew rather steadily from 1968 to 1973, and computations revealed little change in the percentage of agricultural research budgets allocated to agricultural economics.[2]

Support for agricultural economics extension

I found little information on changes in support for agricultural economics extension programs. Extension budgets and personnel have been categorized into various programs, but neither the Extension Management Information System (EMIS) nor other extension classifications gives a breakdown by discipline.

Peterson reported that the number of agricultural economics extension personnel in U. S. colleges of agriculture increased from 369 in 1960 to 490 in 1967; agricultural economics' percentage of the total extension personnel in colleges of agriculture grew from 24 to 26 during this period [7].

Extension reports [2, 6, 13] indicate some increase in the proportion of extension effort devoted to marketing, business management, and community resource development. So it appears that agricultural economics extension work has expanded in absolute terms and probably also as a percentage of the total extension effort.

Future support

The past record of support for agricultural economics indicates that administrators have been at least moderately impressed with our contributions. Our profession has made noteworthy contributions to agriculture, rural people, and society in general. But the past is no guarantee of the future.

Agricultural economists would like to see support for their programs at least maintained. Even that implies budget increases because of rapid increases in costs of just continuing present programs. Beyond maintenance, there are significant new economic and social problems that agricultural economists could help solve if they had the resources.

But funds are now tight enough that professional desire, program maintenance needs, and even greater opportunities for service are not enough to assure budget support.

As we look ahead and consider limited funds and competing demands for them, we must turn to our professional commitment to optimum resource allocation and ask whether the social benefits from additional investments in our programs will exceed the benefits from other uses of funds. Of course, we will have difficulties answering these benefit-cost type questions because of the lack of specification of society's goals, difficulties of specifying an internal objective function for a social science such as agricultural economics, and because of measurement problems. But we will have to do better than we have in the past in addressing such questions. Vague justifications are not going to do the job. Funding sources and administrators will be demanding much more explicit and specific accounting for the outputs achieved through the use of public funds. As one of my reviewers put it, "In the 1960s, it was ask and you shall receive. In the 1970s, it is justify before you will receive."

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[2] To determine the impact of inflation on the support of research programs, all of the dollar figures in Table 2 were deflated, using an index of R&D expenditures developed by the National Science Foundation. To save space, only the current dollar figures are published in the table. But for example; the $48,511,000 total for agricultural economics research shown in column 9 for 1973 amounts to $36,751,000 in constant dollars.

Accountability

The phenomenon that I believe will have the most profound influence on the ability of agricultural economists—or anyone else—to maintain support in the future is *accountability*. In a sense, it is not a new phenomenon. But new manifestations and increased emphasis on accountability are among the most significant developments of the 1970s.

The increased demands for accountability came about partly because of the economic situation and competing demand for funds. Even more important was loss of confidence—especially the loss of confidence in public institutions.

There are various forms of accountability. Everyone is accountable to someone; most of us are accountable to a number of individuals, agencies, and publics. I will stress public accountability; while it applies to everyone, it is especially relevant to those of us who obtain and use public funds.[3]

Accountability as a process requires those who obtain and use public funds to: (1) specify in advance why the funds are needed and how they would be used if obtained, (2) provide feedback information on progress and problems while budgeted activities are being carried out, (3) report, at the end of the budgeting period, how the funds were actually spent, (4) and most important, report what happened as a result of the programs supported by the expenditures. Were the projected results achieved; who is better off because of the program, and how much; who is worse off, and how much; did some things go awry, and if so, why?

Greater accountability is being required of all agencies by the federal executive and by Congress. Both the executive and the legislative budgeting systems now require more detailed specific documentation of projected benefits and other impacts of programs for which funds are being sought. Congress is requiring enough information to judge the relative worth of competing projects before it makes appropriations.

The demand for more accountability for federal funds applies to all of us in agriculture. It applies with special force to state agricultural experiment stations because of a feeling on the part of the Office of Management and Budget (OMB) that in the past there has been too little accountability for formula federal funds allocated to SAES. The same applies, but to a lesser extent, to federal funds allocated to state cooperative extension services.

The demand for accountability is moving as fast, if not faster, at the state than at the federal levels. In the past, many state budget agencies have controlled budgets of state agencies more strictly than they have controlled the budgets of state colleges and universities. But this is rapidly changing.

OMB and many state budgeting agencies seem to be approaching a type of zero-base budgeting. This is a budgetary approach that assumes that you will have zero budget, and that you must justify every dollar you get, including the amounts spent for on-going programs.

Another evidence of the demand for more accountability is the growing tendency for Congress and state legislatures to appropriate funds earmarked for specific purposes.

Federal agencies now demand stricter accounting of expenditures and performance on grants that they support. In 1973 federal auditors began requiring documentation to back up direct expenditures, and more precise justification of indirect costs Procedures are involved enough to imply the need for daily work records of all personnel who have worked on the grant projects.

If you wonder if this is just an exercise, note that the federal auditors started with the institutions that had the most federal grant dollars. They are working their way down the line. When they finished their audit and closed their books at one large university, they said, "You owe us $1\frac{1}{2}$ million." After such an audit, institutions are in the same position as an individual whose income tax return has been challenged by the Internal Revenue Service. They can pay up, prove that the auditors were wrong, or in some cases negotiate a settlement. The federal auditors have the last word, unless one chooses to fight the case in the courts.

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[3] For some interesting parallels to this discussion, see Hildreth's recent paper on "The Legitimacy of Agricultural Economics" [4].

Another area of accountability or social responsibility includes affirmative action requirements on employment, selection of extension audiences, and release of research information.

The accountability we must meet is really only a kind of derived demand, passed along to us because of the requirements of legislative and executive accountability. These bodies have major responsibility for weighing alternative uses of public funds, assigning priorities, and allocating funds among public programs.

Performance—Key to Accountability for Agricultural Economists

The situation demands accountability of everyone, including agricultural economists. The key to accountability is performance. In my estimation, performance is about 90 percent of the job of being accountable.

We have done some good work and useful things in the past. Because of changes in our economy and society and pressure on funds, we will have to rise to new challenges of the future to maintain a record of having useful, quality work to show for funds expended.

Following are some ideas related to performance of agricultural economists. They are not offered as definitive answers, but rather as suggestions.

Working on relevant problems

Selection of more relevant problems to work on is the most crucial step in performance. Of course we want to apply appropriate methods to the problems we work on. But in the past decade, I believe that we have overinvested in the development and refinement of quantitative methods. We have spent too little time and energy on discovering and tackling the emerging economic and social problems that most trouble our society.

We do not have very effective mechanisms for early discovery of important problems. Until we develop improved problem-discovery techniques, we need to spend more time out where the action is. We need to spend more time talking to people, finding out in more intimate detail what is happening to them, what their problems are, and what agricultural economists can and should do to help solve the problems. We need to talk to people like farmers, marketers, processors, and input suppliers; consumers; people in local, state, and federal government agencies; and people in other disciplines. We need to learn how to ask the right questions as prelude to zeroing in on the most important problems.[4]

Extension workers with their frequent contacts and intimate knowledge of the state can play a vital role in helping identify relevant problems for both extension and research—and for teaching, too.

In my younger days I used to question people spending much of their time speculating about future events and problems that might arise, and talking with people about these concerns. I used to say to myself, "I wonder when these people are going to go to work?" But now I believe that those who nose about, talk to people, dream a little, and in the process ferret out some of the most urgent problems, are some of the very most valuable members of the profession. They ought to be recognized and rewarded for their contributions.

I am not sure what the highest priority problems are. I am sensitive to the present demands for emphasis on food production. I believe we have overly de-emphasized work in farm management. But given the necessity for choice, I believe agricultural economics should devote relatively more of its resources to work in the areas of human resource development, improving incomes and living conditions of low income people in rural areas, equity in income distribution, population distribution, problems of rural communities, and problems of energy and the environment.

Extension economists have the challenge, among other things, of providing better understanding of public policy issues. Examples include the effect of devaluation and exchange rates on farm prices and why the U. S. must export farm products even "when food is scarce and prices are high."

Agricultural economics teachers are challenged to make more effective use of teaching budgets. They need to avoid misdirections that parallel the researchers' methodology "trap." We could consider putting less emphasis on advanced degrees that require massive inputs of student and faculty time on dissertations. We might give the Doctor of Arts and other degrees a fairer trial—degrees that may require papers or other performance to demonstrate the students' abilities and that prepare them for the many jobs they go into besides research. The same rationale applies at the master's level. Some of the highest payoffs in teaching may come from designing agricultural economics courses specifically to meet the needs of nonmajors.

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[4] One of our challenges will be to have close liaison with many audiences without letting any particular clientele group dictate our programs.

Many people have called attention to the agricultural economists' ability to integrate information. Perhaps we need to put more emphasis on this role—looking at a whole firm rather than a commodity; looking at an entire production and marketing system, rather than only a portion of it; looking at the entire structure of agriculture and its linkages with the rest of the economy; looking at rural areas and their linkages with the rest of society.

We ought to do more to serve other disciplines and more work on multidisciplinary teams. In many cases the economist can contribute by insisting that important economic questions be faced at appropriate places in the project. Frequently, the biggest contribution of our profession has been to help synthesize results from different disciplines.

Ultimately, our worth must be judged in terms of our contribution to people, to society, to the quality of life. I have a long-standing and deeply held conviction that the most important mission of agricultural economists is *to help people.* I presume that helping people is the objective of all disciplines. But it seems to me that the relationship is more direct and immediate in the case of social scientists than for physical or biological scientists. And I expect agricultural economists, as one of the most applied group of social scientists, to think about this obligation often and explicitly.

Allocation processes and the necessity for hard choices

We need to improve our processes for deciding on priorities and allocating resources among public programs, including agricultural economics extension, research, teaching, and international programs. The past decade has seen much investment in development of improved systems of planning, allocating resources, and budget management, starting with program planning and budgeting systems in the federal government. Agricultural economists have contributed a great deal to such developments.

Whatever allocation processes we use, in the future limited budgets will require hard choices among alternative uses of funds.

With limited budgets, hard choices among programs will simply have to be made. We cannot do everything for everybody in teaching, research, extension, or any other line of work. We never really have been able to, and we certainly cannot now. With the budget constraints we face, if we are going to move ahead in high priority new areas, we will have to shift resources from existing programs.

We will have to say "no" every once in a while. All of us. Staff are sometimes less effective than they might be because they will not stop accepting responsibilities and thus spread themselves too thinly. Also, staff typically prefer to put pressure on administrators than to tell clients they do not have the resources to undertake new programs that have been requested. Administrators also find it hard to say "no." They tend to harbor a vague feeling that if they respond favorably, their unit may gain the approbation of those who will be voting for funds in the future.

As Elliott Richardson put it, "Choice is the basic reality, and for us it is doubly difficult and saddening because whatever we have to give up is not something bad or trivial, but something that is only somewhat less important, if that, than what we have selected to do" [8].

In agricultural economics, we need to do more than we have in following up to evaluate the actual impact of our programs. How did our predictions and projections work out; what really happened to people out there as a result of our programs? We particularly need to give more attention to people who may be affected adversely than we have in evaluating many public programs in the past. This is an important part of the social accountability concept. I am aware of the difficult conceptual and measurement problems involved

Improving our record at predicting

Many people, both in and out of the profession, believe that our biggest shortcoming is our failure at predicting. While our record at the micro level has not been too bad, we will have to admit that our record at the macro level has not been the best.

Maybe our tools for forecasting were not as sharp as we thought they were. Surely we have not spent enough time, money, and energy following up on our predictions, seeing where we went wrong, and evaluating our predictive instruments. Part of the problem is that we recently have faced greater change and uncertainty than we have during most of the life of our profession.

It appears that we have not built the increased complexity of modern society into our systems of analysis. Perhaps getting out into the field more, as mentioned previously, would be helpful in including relevant variables.

I am most concerned about our failure to predict economic and social phenomena like the behavior of our economic system, inflation, unemployment, farm prices, consumer prices, and aggregate incomes. Perhaps part of our shortcoming relates to our recent de-emphasis on macro economics work, both by economists in the profession and in our graduate programs.

Organization and division of labor

In being accountable and making most effective use of our extension, teaching, and research resources in agricultural economics, we should give some attention to specialization and division of labor. We need to give careful attention to who is already in motion on similar programs and how the comparative advantages are distributed.

By the late 1960s private industry was conducting over half of the agricultural R&D work in the U. S.; in the future it could account for 75 to 80 percent of the R&D work in the traditional areas of plant and animal sciences [5].

Private industry tends to concentrate on developing and testing new inputs such as new crop varieties, fertilizers, chemicals, feeds, and machinery. It also does considerable R&D work in marketing, processing, and distribution. It tends to focus on producing knowledge that can be embodied in differentiated products or services that can be marketed in such a way as to give the sponsoring firm substantial control over revenues accruing to the development.

Extension and research staffs of the USDA and the colleges and universities can appropriately concentrate on problems that are of a public nature or are too complex to be handled adequately by someone else.

Expansion in the amount and kinds of research and consulting done by private industry, the broader range of problems tackled by public agencies, and increased diversity of funding has led to greater need for coordination among the different groups involved in R&D.

While the final outcome is not yet clear, I am pleased to see the seriousness with which the USDA and the land grant universities are participating in present efforts at regional and national planning and coordination. All of the major research agencies of the USDA, extension, and private industry are involved in this effort. The increased contact and communication are already paying off in identifying some of the major problems and in understanding the involvements and strengths of the various agencies and the kinds of problems they face in conducting their programs.

I believe the Agricultural Research Service (ARS) has been more effective in coordinating its programs with the universities and industry than ERS. ERS's ambivalence with regard to the number, location, and role of its field staff makes the job of coordination with the states more difficult. In 1972 an advisory committee to ERS urged its administrators to resolve this question soon. It also encouraged ERS to undertake further discussions with the universities to improve understanding of the roles of each and to develop new forms of cooperation to increase complementarity [12]. ERS has already moved to place a staff person in the Cooperative State Research Service (CSRS) to work on station reviews and to strengthen communications with CSRS and SAES.

Much of the research, extension, and teaching work that needs to be done requires contributions from a number of disciplines. Our record of working with production departments in colleges of agriculture is fairly good. But we have a long way to go. We particularly need to strengthen our multidisciplinary working relationships with other social sciences—economics, sociology, psychology, and political science. We might consider joining other social scientists to push for a Social Science R&D Act to obtain support for R&D programs related to some of the more urgent social problems of the day.

We need to think more in terms of R&D groups that involve both research and extension. There should be far less distinction between research and extension programs than we have in most states. It is hard to distinguish whether certain activities are extension or research, and we should not waste so much time and energy trying to do so.

We also need to work on coordination of our teaching and extension programs with community colleges and continuing education programs.

We need to reconsider the relationship between research and graduate education. Some have argued that it is necessary to have a strong graduate program in order to have a good research program. I think this is an incidental, possibly even spurious relationship. Organizations like Resources For the Future, for example, produce excellent research without graduate programs. Graduate education is a teaching function, and one that requires a great deal of faculty time.

Agricultural economics researchers could obtain greater leverage in their programs by pushing for more aides on grant funds or wherever they can get them.

If agricultural economics researchers are in need of more aides, extension workers need them even more. Output of extension specialists could be greatly increased through more aides to screen literature, prepare educational materials, and in some cases, to help conduct educational programs. Also, some agricultural economics teachers could make more effective use of more teaching assistants or other aides.

Communicating with our audiences

Accountability and achieving effectiveness in our programs require a great deal of communication and close working relationships with various audiences.

I am concerned about the wide communication gap between our profession and many of our clientele. I believe extension economists, for the most part, do a good job of communicating with their audiences. We fall down most in communicating research results. I believe the reasons are: (1) the relevant decision-makers do not find out about the research; (2) they find out about it, but have difficulty understanding what the researcher has said; (3) the researcher has not pushed the analysis far enough to make it most useful; (4) the research is so far out of date, it is no longer useful; (5) extension and research staff fail to coordinate their efforts in getting research results out to decision-makers.

We can improve our performance by working closely with potential users of our research. Partly we need their inputs into the research, and partly we want to develop their interest in our research and prepare them to use the findings.

We need to push much, much further than most of us have in the past in making the information useful to decision-makers. In some cases this may mean pointing out the cause and effect relationships more clearly. Often we must go further in recommending solutions. Typically, we must provide additional explanations and interpretations of the results for use by decision-makers.

We need to put out our information in the most appropriate form to get our message across to whatever audience we are trying to reach. Let us face the fact that most researchers write for other researchers. Thus, most of their journal articles or research bulletins should be followed by an extension publication that transmits the applicable results to client groups in plain English.

And we need to get our results out a lot faster than we sometimes do. In some cases, we need to be bold and innovative enough to release intermediate results before the entire project is completed to the researcher's satisfaction. Intermediate results will sometimes be highly useful to our audiences. Releasing them earlier is a way for agricultural economists to be more relevant, more accountable.

I mentioned before that 90 percent of performance is working on relevant problems (and assumed that the work would be done in a competent manner). In my estimation, performance also constitutes about 95 percent of the public relations job we need to do. The other 5 percent is to inform people of our progress and our accomplishments—and also our problems and needs. Perhaps more than 5 percent will be required in the future.

Grant support

We need to give more attention to grant support for agricultural economics programs as a means to augment lagging support from state and federal appropriations.

There has been a presumption that agricultural economists have less opportunity for grant support than do biological scientists since federal funding agencies and commodity organizations have concentrated heavily on physical and biological sciences.

From a printout obtained through the Current Research Information System (CRIS), I studied the grant support reported on the agricultural economics portion of all SAES projects in 1967 and 1973. Reporting on grants is admittedly incomplete. But, for what it is worth, the CRIS information showed that agricultural economists on the average had a larger proportion of their financial support in grants than did the SAES as a whole, and that in terms of current dollars, grant support of agricultural economics research increased by more than 50 percent from 1967 to 1973.

In 1973 more grant support was reported for research in natural resources than any other area of agricultural economics. Grant support in the international area was second, and in the human and community resource areas, third. While it still lagged behind these areas, grant support for agricultural economics research related to commercial agriculture increased sharply from 1967 to 1973.

In the future I can see possibilities of agricultural economists obtaining increased grant funds in the community and human resource areas, energy, environmental quality, and transportation, including funds through the National Science Foundation's program on Research Applied to National Needs.

In the past extension workers have done relatively little to obtain grant funds to support their programs. I believe they have been missing an opportunity and suggest in the future they could obtain considerable grant support from federal agencies, state agencies, commodity groups, and private foundations.

Agricultural economics teachers, too, may be able to tap grant sources to support teaching innovations.

Obtaining grant funds is hard work and sometimes frustrating. Given individual differences, we should be able to manage our budgets so those most motivated and adept at obtaining grant funds are encouraged to do so. Those who find the task too onerous can be supported from other funds.

For the most part, we ought to concentrate on obtaining grants that will supplement current programs, and let us pursue the programs we have decided are most urgent. In some cases, however, large grants will permit us to hire enough professional people to open up important new areas.

Grantors demand accountability. We are accustomed to having them impose deadlines and demand a finished product. In the future, however, given trends in the demand for accountability at the federal and state levels, grantors are not likely to require more accountability than will be required for appropriated funds.

Who's Accountable?

As I thought about this paper, a question kept running through my mind. That was—in obtaining resources, in deciding on their use, and in providing accountability for them—who is responsible within our system?

In the past there has been a strong tendency to assume that the bigger job of getting the resources is the responsibility of administrators. And when it came to the question of accountability, many staff seemed to have the attitude, "Don't bother me—let the boys in the accounting offices with the green eye shades take care of it, and let me do my job. Just get me the money; I know what to do with it."

While this is an understandable stance and may have been acceptable under some circumstances in the past, it is no longer a viable approach. Everyone has accountability responsibilities. Let us explore some of them.

Agricultural economics professionals

Let us first discuss the role of the agricultural economics professionals (staff) in government, industry, nonprofit organizations, and colleges and universities. In my estimation they are by all odds the people who do our most vital work.

Staff have the major responsibility for determining the directions of their programs. They can and should be able to identify some of the most important problems in their area of expertise. They are in best position to determine which programs it is feasible to undertake, the techniques appropriate to the problems, and the amount of resources that are needed to carry out the activities.

But staff often are not in the best position to evaluate the priority that society places on various goals. Since these priorities are an important part of resource allocation, others besides the staff have a legitimate claim for a voice in allocation decisions. The public and executive and legislative bodies are involved at certain levels in the process. Administrators are being called upon to become more involved in allocative decisions within the units they administer.

Given the pressure on funds and the demands for accountability, I conclude that in the future, staff will have somewhat less voice in determining the direction of their programs than they have in the past. But I also conclude that in many organizations, such as colleges and universities, they will still have more influence on the direction of the program than anyone else.

Edgar Schein of Massachusetts Institute of Technology, with support from the Carnegie Commission on Higher Education, did a thoughtful analysis which he published under the title, "The Reluctant Professor: Implications for University Management" [9]. In it he points out that historically the staff has limited its role to scholarly, teaching, and service functions of the university. They have viewed the "maintenance function"—maintaining support—as being the job of "the administration." Schein concludes by saying that the question of whether the staff should become more involved in maintenance functions is an academic one because there is no choice. Of their own volition and because of the pressures of events, university staff will become more involved than they have been in the past in both maintenance and governance. Similar analysis would apply to other organizations in which agricultural economists are employed.

If my previous comments regarding the relationship between performance and accountability are anywhere near correct, staff can make major contributions to accountability by working on relevant problems, by using techniques relevant to the problems, and by making the most efficient use of the resources they control—as they have for the most part in the past.

But in the future the staff will have to be more accountable by providing information on the impacts of their programs and justifying needs for new programs.

I am concerned about the burden on teachers and researchers to perform maintenance, governance, and accountability functions on top of their traditional work assignments. I am concerned about the heavy demands on many ERS staff to provide short-term advisory services to the executive and legislative branches, and the extent to which this detracts from the main mission of that organization, which is research.

If we agree that staff involvement in many of the maintenance and accountability and other functions is essential, we then need to think in terms of changes in appointment and changes in evaluation procedures to compensate for this involvement.

I believe that those who work at obtaining support and help provide accountability information will be rewarded with stronger support for their programs; they are also likely to have more to say about the direction of their programs than those who do not.

Many agricultural economists and others have argued that the rewards system, especially in universities, discourages work on practical problems and participation in multidisciplinary teams. Instead, they say, staff are rewarded for the more abstract articles that are accepted by national professional journals. My judgment is that changes now occurring will make such pronouncements obsolete in the very near future, if it has not happened already.

The demands of accountability will increasingly lead administrators at all levels to conclude that staff who produce useful results, who help solve problems, and who work on multidisciplinary teams should be rewarded for their efforts with salary increases and promotions. Of course, the system will operate imperfectly, as it has in the past. But when administrators decide on the kind of behavior they want to reward, significant progress can and will be made.

We noted that accountability requires staff to respond to changing needs of society. I probed for evidence of changes agricultural economists had in fact made in their programs. The most definitive indicators I could find were in research. I obtained printouts from CRIS on all projects that included agricultural economics in 1967 and 1973. With help from the Agricultural Economics Department at Washington State University, I sorted this mass of information by performing organization and research problem area (RPA).

Changes in scientist years in SAES by categories are shown in Table 3. There were significant shifts, especially toward international trade, human and community resource development, and environmental quality. I would give agricultural economists involved a high score on the responsiveness scale.

Administrators

In the past, administrators have been accused of exerting too little leadership of the units they administer. This comment has been made most often about deans and directors in colleges of agriculture, and I believe the observation is a cogent one. In the past many administrators have felt their major responsibility was to hire good staff and turn them loose. This *laissez faire* approach by some administrators has been partly due to their concept of their role, partly due to their confidence in the staff, partly due to the demands on their time, and I suppose in some cases, due to lack of initiative.

Given the budget situation, rapid emergence of new problems, and the demands of accountability, more leadership will be demanded of administrators in the future. Administrators can transmit to the staff needs communicated to them by various audiences. They should put information together (including information from the staff), make decisions, and take action. Tighter budgets and accountability demand more of administrators.

One of the more important functions for which administrators should be held accountable is to create and maintain an environment in which staff can do productive work. This includes providing help and encouragement to the staff. Department chairmen have a key role because of the close contact that they have, or ought to have, with the staff.

Table 3. Scientist years for research, agricultural economics, state agricultural experiment stations, by category, 1967 and 1973

Category	1967		1973		Change 1967–73	
	SY	Percent of total	SY	Percent of total	SY	Percent
Food, fiber, and forestry production	94	21.3	103	19.5	+ 9	+ 9.6
Food, fiber, and forestry marketing	107	24.3	80	15.2	—27	— 25.2
Structural and policy analyses	108	24.5	124	23.4	+16	+ 14.8
International trade and development	12	2.7	17	3.2	+ 5	+ 41.7
Natural resources	59	13.4	71	13.4	+12	+ 20.3
Community and human resources	48	10.9	109	20.6	+61	+127.1
Environmental quality	9	2.0	20	3.8	+11	+122.2
Agricultural statistics	4	.9	5	.9	+ 1	+ 25.0
Total	441	100.0	529	100.0	+88	+ 20.0

Source: [11].

- Administrators are accountable for fair and objective operation of the evaluation and reward system, and they still have major responsibility for obtaining support for programs of their units, and for seeing that accountability requirements of funding agencies and the public are met.

A major responsibility of administrators is reallocating resources in light of changing needs. Many have said that the percentage distribution of resources never changes—especially in agricultural experiment stations. There is some evidence that through the 1950s and much of the 1960s, there was little change, at least in the relative proportion of SAES funds going to different disciplines.

To see whether this was still true, I obtained information on shifts in program emphasis in SAES from 1966 to 1972. A summary of shifts among commodity or resource groups is in Table 4. I believe you will agree that there have been some rather significant changes. By comparing Tables 3 and 4, I would give agricultural economics researchers a better score on change than the directors. I think it is fair to say, however, that directors operate under more constraints than the staff.

It is probably true that SAES directors have not made as much change as they should have in the past. Perhaps they are not making changes as quickly as they should now. But budget exigencies as a negative force, and our research planning efforts as a positive force, appear to be leading to more rapid change.

Students

Agricultural economics students are accountable too. Many are accountable to their parents who are paying for a significant part of their education. All are accountable to society, since tuition fees pay only a fraction of the costs of higher education.

Teaching assistants, I believe, have always

Table 4. Scientist years for research, state agricultural experiment stations, by commodity or resource groups, 1966 and 1972

Commodity or resource group	1966		1972		Change 1966–72	
	SY	Percent of total	SY	Percent of total	SY	Percent
Natural resources	1018	16.4	1149	19.0	+131	+13
Horticultural crops	1254	20.1	1188	19.6	— 66	— 5
Field crops	1298	20.8	1170	19.3	—128	—10
Livestock and poultry	1535	24.7	1258	20.8	—277	—18
Human resources and institutions	361	5.8	474	7.8	+113	+31
Other	758	12.2	819	13.5	+ 61	+ 8
Total	6224	100.0	6058	100.0	—166	— 3

Source: [14].

been held accountable for performance on their assistantships. In the past some research assistants have treated the assistantship as if it were a fellowship. In most institutions the day of such "free rides" is over, and accountability will require an output in return for an assistantship stipend.

AAEA

Finally the American Agricultural Economics Association should be held accountable to the profession.

The profession has the right to expect information, ideas, and intellectual stimulation from its professional society.

AAEA should evaluate the performance of the profession on a systematic and continuous basis.

The Association should help discover some of the more significant problems for agricultural economists to work on, and could possibly help in obtaining support for agricultural economics work.

If we put enough effort into it, AAEA could help bring about greater coordination of agricultural economics work in the U. S. This could include studies that might influence decisions on specialization and division of labor among the various organizations involved in agricultural economics work.

The Association should continue actions to improve our data base [1].

Research, teaching, and extension in agricultural economics could all be improved through more efficient information data storage and retrieval. I am hopeful that the retrospective literature search system being developed by AAEA will be helpful for part of this task.

Members can reasonably expect their Association to provide information on the needs for people with different degrees in agricultural economics. This information should help graduate students select areas of specialization and those in established jobs who desire a change in employment. I would hope the National Employment Registry for Agricultural Economists will be useful in this regard.

AAEA certainly ought to be able to assist in communicating agricultural economics information more effectively to audiences with little formal education in economics. Perhaps AAEA ought to consider publishing one or more popular publications addressed to current issues and made attractive to the general public. Some publications would be useful to many agricultural economists and to many leaders who are not professional agricultural economists by background.

Like other forms of accountability, this is a two-way street. Members of the profession are accountable to their association and can be expected to support it with their time, money, and participation

Conclusion

I know I have asked a lot of you—to be relevant, responsive, accountable, and innovative. You can reasonably ask, "What right do you have to demand all of this of us?"

Well, actually I do not have any right at all. It is just that as I appraise the situation, I have strong conviction that those who are most accountable will receive the greatest rewards, not only in terms of personal and professional satisfaction of having contributed to the solution of some of society's most urgent problems, but also in more tangible ways.

I emphasize my plea for agricultural economists to be more bold, more daring, more innovative everywhere—in the classroom; in research; in the extension and public service arena; in government; in private firms.

In the words of Senator Fulbright, "We must learn to explore all the options and possibilities that confront us in a complex and rapidly changing world. We must learn to welcome and not to fear the voices of change. We must dare to think 'unthinkable things' . . ." [3].

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INVITED ADDRESS

Some Impacts of the Changing Energy Situation on U. S. Agriculture*

HAROLD O. CARTER AND JAMES G. YOUDE

In his Presidential address three years ago, Vernon Ruttan stated that we were in the second major wave of concern about natural resource policy since World War II and the fourth since Malthus [28]. The first postwar period of concern occurred about 1950 and emphasized the relationship between available and projected resources and economic growth. The oft-quoted but little-heeded reports[1] of the President's Materials Policy Commission [23] and the Water Resources Policy Commission [24] were basically concerned with scarcity or, in contemporary jargon, "short-falls." Scarcity was defined more as a physical concept than an economic one, relating production capacity and reserves to projected needs. The second postwar wave, according to Ruttan, shifted from traditional concern for adequacy of the natural resource base to stress on environmental consideration and economic growth.

Energy-related events of the past two years, involving both fuel and food, have created a third wave of concern about natural resources. Its sudden and pervasive impact could be characterized as a "tidal wave." The current dialogue more closely resembles the issues of resource adequacy stressed in the early 1950s than the more recent environment-centered concerns, yet there are elements of both.

Energy price increases apparently are a more permanent phenomenon than the types of shortages experienced last winter. Energy real prices, after trending downward for about two decades, have increased dramatically during the past year. We argue that the central energy issues facing U. S. agriculture are more price-related than supply-related. We further contend that major long-term adjustment problems for agriculture will result indirectly from the impact of energy prices on general price levels and economic growth rates, rather than from direct price increases of energy-based farm inputs (electricity, fuel, fertilizer, and chemicals).

Energy and World Prices

From 1966 through 1972, world commodity prices trended upward at a steady but modest rate (Fig. 1). While many developing countries experienced persistent inflation during and prior to this period, reasonable monetary stability existed in most industrialized economies. Government policy in the developed nations focused mainly on economic growth and employment.

Since 1972 world commodity prices have risen at rates unequaled for over a quarter of a century. A major contributor has been the nearly threefold increase in crude oil prices by the Organization of Petroleum Exporting Countries (OPEC) since October 1973. Previously, wellhead prices in current dollars had risen only modestly for 25 years.[2]

Current inflation differs from previous inflation in two ways: it is worldwide in scope, and it is commodity-based. Mid-1974 data showed prices increasing at annual rates of 35 percent in Brazil, 26 percent in Japan, 19 percent in France, and 10 percent in the U. S. [15, p. 66]. At the same time, 1974 real economic growth is expected to reach only 1.5 percent in the Organization for Economic Cooperation and Development (OECD) countries. No country, industrialized or developing, has escaped.

Oil price increases exert both direct and indirect upward pressures on aggregate price levels.[3] Direct effects are closely correlated with

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[1] For example, with reference to energy, ". . . the Commission recommended that a single Federal agency be designated to keep the entire energy situation and long-range outlook for all energy sources under review . . ." [23, p. 170].

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[2] In real terms, wellhead oil prices fell from 1955 to 1972 [25, p. 35].

[3] Rolfe contends that crop failures and crude oil price increases by OPEC have at most been marginal contributors to inflation; ". . . had there been no endemic

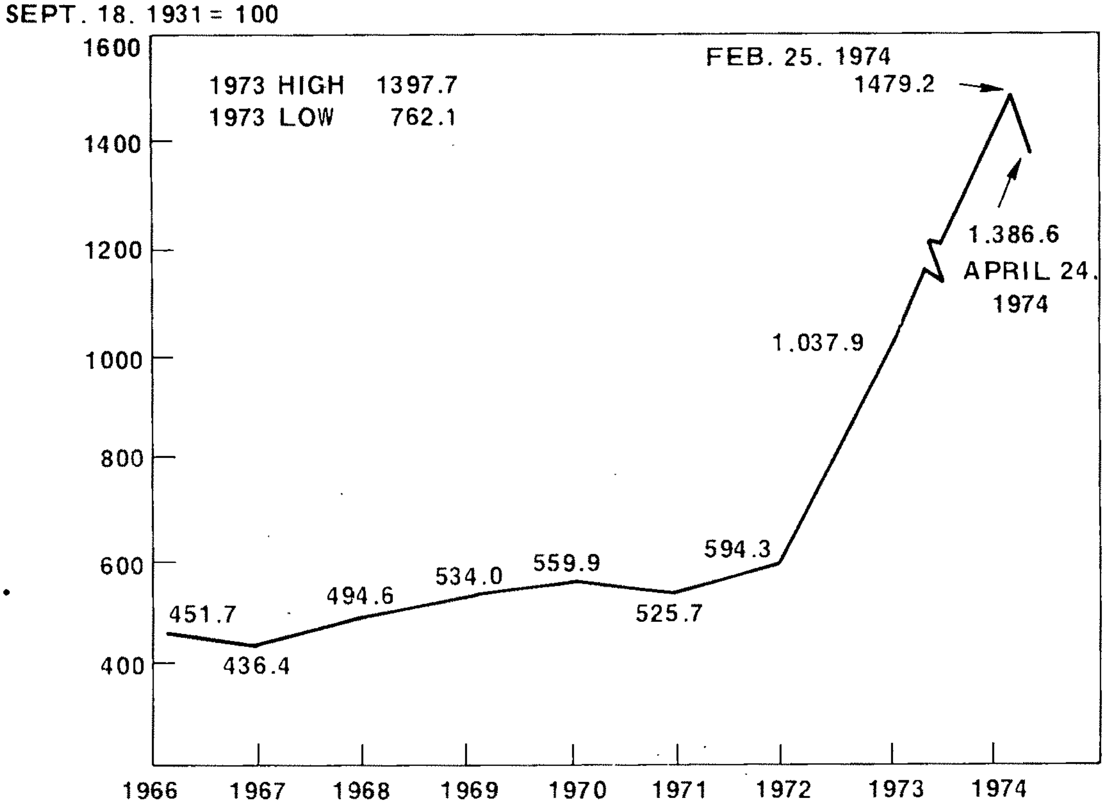

Figure 1. World commodity prices (Reuters United Kingdom Index)*

Source: [6].

* Annual averages unless otherwise indicated.

the reliance of a country on high-priced energy imports. Indirect impacts occur as these higher energy costs become built into the price structure of other goods and services. Energy price increases are more far-reaching and permanent than, for example, food price increases. Conlan recently noted that "the pass-through of energy costs in the industrial system has barely begun . . . the direct and indirect effects of energy price increases will cause continued high rates of inflation for as long as it takes to adjust to the new economics of energy" [6, pp. 11–13]. The energy-based nature of current price rises suggests a shift from demand-pull to a cost-push type of inflation.

Meanwhile, double-digit inflation continues in the U. S., with no clear signs of relief on the horizon. Energy-related products accounted for about 29 percent of wholesale price increases and 18 percent of retail price rises during 1973 and the first quarter of 1974. Food price rises contributed another 23 percent to wholesale price increases and 40 percent to the consumer price index. Together, food and energy prices accounted for direct increases of 52 percent in wholesale prices and 58 percent in retail prices during that period.

Energy Prices and Demand for U. S. Agricultural Products

Domestic demand

Domestic demand for agricultural products will be affected by increased energy prices to the extent that those prices affect economic growth rates, general price levels, and income distribution. Recent forecasts of real GNP growth in the U. S. during 1974 range from —0.8 percent to 0.6 percent. The same forecasters project inflation to continue at rates of 7.8–9.3 percent this year. These forecasts are described as a profile of "a sluggish economy that is still plagued by roaring inflation" [31, p. 52].

If these projections of a no-growth (and per-

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inflation, the shortages might have raised prices as a whole 1 or 2 percent although more than that for specific goods (wheat, beef, gasoline, and so forth) . . ." [27, p. 14].

haps recessive) economy with "roaring inflation" prove accurate, what are the likely impacts on domestic demand? We would expect per capita consumer demand for those products with high income elasticities—including meat, frozen fruits, and vegetables [9]—to plateau and perhaps decline. On the other hand, the demand for those "staple" products (e.g., wheat and other cereals) consumed as substitutes for the more income-responsive commodities would be expected to increase. Increasing evidence suggests that consumers are "trading down" in response to rapidly rising prices of food and other products.[4]

International demand

U. S. agriculture is highly dependent on export markets, given current production levels. This country's agricultural exports totaled about $21 billion in fiscal 1974, a 63 percent rise over the previous year, with about three-fourths of this higher value resulting from increased commodity prices. It is estimated that the production from almost one-third of U. S. cropland is sold in export markets [7, p. 52], with about 70 percent of all purchases made by other developed countries [37].

Energy prices are likely to affect world demand for U. S. agricultural products indirectly through their impacts on world inflation (discussed above), balance of payments, economic growth rates, and relative currency valuations.

Balance of payments.—Energy price increases have a large and continuing impact on balance-of-payments accounts, international financial markets, and world trade balances. At present consumption levels, world oil import costs will jump from $45 billion in 1973 to about $115 billion in 1974, or about a $70 billion increase.

A nation may correct international payments account imbalances that result from higher oil prices by adjusting its current account (trade, services, and unilateral transfers) or its capital account. In the first case an oil-importing country increases its exports, or decreases non-oil imports, to offset higher imported energy costs. In the second case capital accounts can be adjusted by a drawdown of foreign exchange reserves or the receipt of loans and investments from other countries [34, p. 3].

Several countries recently have curtailed agricultural imports because of large trade imbalances resulting from increased energy prices. Japan and the United Kingdom suspended beef imports for short time periods, and Japan is attempting to reduce trade deficits through cancellations, deferrals, and resales of food commodities [17].

Economic growth.—The balance of payments and inflationary problems are dampening GNP growth rates in most advanced countries. Rapid inflation is eroding real incomes, reducing economic demand for goods and services, and encouraging restrictive government monetary and fiscal policies. Real GNP growth is projected at only 1.5 percent for the OECD countries in 1974. Japan, a country that imports 85 percent of its energy requirements, is expected to experience real economic growth of 2 percent following an 11 percent increase in 1973. In the European Economic Community (EEC), GNP growth is expected to fall from 5.7 percent in 1973 to about 1.5 percent in 1974, with Great Britain's troubled economy projected to experience a 1 percent negative real growth [15, p. 67].

Energy price increases will affect the world's developing countries in a variety of ways and to varying degrees. It has been estimated that imports of petroleum, food, and fertilizer will cost the developing countries $15 billion more in 1974 than in 1973. Of this total, oil import costs are expected to account for $10 billion, an amount roughly equal to developing nations' increased commodity exports during the past two years 34].

Developing countries have been placed in four categories relative to the probable impact of energy price rises [35]. The oil-exporting countries of the Near East and Latin America will benefit economically from this development. A second group of countries will not be seriously affected because they do not import significant amounts of energy-related products.[5] A third group—including Greece, Spain, Turkey, Yugoslavia, South Korea, Taiwan, and Hong Kong —are closely linked to, and therefore adversely affected by, economic stagnation in industrialized nations.

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[4] Most U. S. food demand studies have been based on periods considered more "normal" with respect to price, quantity, and income changes than during 1972–74. Therefore, we need answers to the following questions: Do rapidly-rising money (but not necessarily real) incomes cause consumers to adjust food purchases as a result of a "money illusion"? Conversely, do rapidly-rising food prices induce consumers to adjust their food and non-food purchasing patterns even if real income changes are small? What impacts do food stamps have on the consumption and demand patterns of lower-income groups?

[5] These include: People's Republic of China, Columbia, Mexico, Bolivia, Brazil, Ecuador, Peru, Malaysia, Morocco, Tunisia, Zambia, and Zaire.

The fourth group includes about 40 countries likely to be most severely affected by oil price rises. Located in tropical Africa, South Asia, and the Central American-Caribbean area, these nations have about 900 million people. They may be forced to reduce imports of goods (in addition to oil) for consumption and development purposes, curbing economic growth rates and further reducing living standards [35]. Cutbacks in agricultural technology investments, including fertilizer, could push food output expansion below population growth rates in these countries. Hardest hit will be the recently-developed, high-yielding crops requiring chemical fertilizers and pesticides.

This worldwide retardation in economic growth rates is occurring simultaneously and in part because of the inflation and balance of payments problems discussed above. It has significant implications for U. S. agricultural trade. Because other developed countries (Western Europe, Canada, and Japan) purchase about 70 percent of U. S. food and fiber exports, their economic status has a crucial impact on U. S. export demand. International demand for staple food crops—e.g., wheat, rice, and pulses—probably will not fall and may even expand from population pressures. However, world demand growth rates for products with higher income elasticities—including meat, fruits, vegetables, and nuts—likely will decline. This in turn will affect export demand for U. S. feedgrains, soybeans, and specialty crops.

Currency valuation.—Combined with growing consumer affluence in developed countries, U. S. dollar devaluation in 1971–73 contributed to continued high demand levels for U. S. food and fiber products—placing upward pressure on world and U. S. agricultural prices. Although the prices of U. S. agricultural exports increased by 58 percent in 1973 over 1972, about two-thirds of the increase was offset by currency realignments and increased purchasing power in 11 major foreign markets. However, increased oil prices have placed considerable devaluation pressure on the currencies of several Western European countries and Japan as their foreign exchange reserves diminish. Thus, the products of these countries have become relatively cheaper in world markets. The U. S., on the other hand, has lost some of the agricultural export advantages it gained as a result of dollar devaluations in 1971–73.

Given the problems that both developed and developing nations[6] face as a result of increased energy prices—foreign exchange shortages, rampant inflation, and depressed economic growth rates—it is improbable that world markets for U. S. farm products will expand significantly during the next several years.

Energy and the Food System

Mayer and Seevers [19] and others have argued persuasively that the U. S. and world food systems have several dimensions and interrelationships that require integration and analysis for effective food policy. Similarly, any meaningful analysis of energy prices and agriculture must focus broadly on the food system —from producer to consumer.

Steinhart and Steinhart [30] analyze the U. S. food system in terms of energy use for the period 1940 to 1970. Total energy use has increased more than threefold during the last three decades. About 25 percent of this energy use is for farming, 40 percent for processing, and 35 percent for home refrigeration and preparation. Hirst [12] estimates that of the total U. S. energy use in 1963, 12 percent was devoted directly and indirectly to the production, processing, transportation, trade, and consumption of food.[7]

The potential adjustments to increasing energy prices at each sector level depend on many variables, but these studies suggest that greater opportunities exist for conserving energy in the food system off the farm than on the farm.

Farm Sector Energy Use

Production agriculture in the U. S. has become increasingly energy-intensive. This has been partly in response to relatively cheap energy supplies. Another reason is that agricultural commodity programs have been capitalized into land prices and have imposed constraints on the land input that make it profitable to substitute freely fertilizer, pesticides, and machinery inputs. Also, the social costs of waste and residue

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[6] Canada, a notable exception, is expected to achieve a real growth rate of 5 percent in 1974 [15, p. 97].

[7] Annual growth in food system energy use from 1960 to 1970 is estimated at 3 to 5 percent [30, 12]. Hirst claims that increased per capita food energy use accounted for 60 percent of the decade's food energy growth, while population increases accounted for the other 40 percent.

Table 1. Indexes of farm outputs and farm inputs, U. S.: 1940–1972 (1967 = 100)

	Farm Outputs			Farm Inputs				
	Livestock products	Crops	Total	Farm labor	Farm real estate	Mechanical power and machinery	Fertilizer and liming materials	Feed, seed, livestock purchases
1940	61	67	59	269	105	43	14	43
1950	75	76	73	199	107	80	32	64
1955	85	82	81	170	107	93	45	73
1960	87	92	90	134	101	92	54	84
1965	95	98	97	109	101	95	80	92
1970	106	100	102	89	98	101	113	109
1972	111	113	111	85	101	102	120	110

Sources: [8, p. 348, and 1, p. 446].

disposal and displacement of farm labor have been undervalued and not fully internalized into agricultural costs.

While U. S. farm output from 1940 to 1972 increased nearly 90 percent on essentially the same acreage, farm labor inputs fell by two-thirds. During the same period fertilizer use on U. S. farms increased almost ninefold, and mechanical power and machinery input grew by 237 percent (Table 1).[8]

Since the energy crisis became a household word, numerous publications have appeared with recommended energy-conserving practices for agriculture. For example, one study estimated that if 20 percent of the manure generated annually by U. S. livestock producers were used on corn, about 17 million acres could be fertilized at a savings of 1.1 million kcal per acre [22]. But that study assumed a manure-hauling distance of one mile, and hence, the energy saving is considerably overstated. Also, the energy required to produce all those manure spreaders cannot be ignored.

But, generally speaking, there are ways to reduce farm energy use:

—The energy efficiency of farm machinery may be improved by using machines precisely scaled for particular jobs and maintaining them properly.

—More careful monitoring of water would result in less waste.

—Grain and forage-drying systems could be designed to use optimal combinations of solar and artificial heat.

—Minimum tillage practices could possibly reduce energy consumption in some cropping systems.

—Plant breeding could emphasize resistance and thereby reduce pesticide-energy requirements and could also improve plant efficiency in converting fuel energy to food energy.

But in all cases the trade-off between energy conversion, yields, and other input requirements and costs must be considered. However, some have argued that, as fossil fuels become scarce and expensive, U. S. agriculture can survive only by reversing the trend of reduced labor inputs per unit of crop production. One writer [21] suggests that food production efficiency be measured in terms of energy conservation—a proposal which has considerable merit if and when the price ratios between energy and other inputs approach infinity.

While it is possible to document the energy intensity of U. S. agriculture and the bio-physical potentials for decreasing energy consumption, it does not follow that U. S. farmers are economically irrational in their use of energy. Likewise, one should not expect a rapid shift toward energy-conserving practices merely because of social concern about the adequacy of energy resources. The capital stock for agriculture and other basic industries was built during a period when current and expected energy prices were low relative to other productive factors. Machines would need to be redesigned with respect to energy consumption. Even if large energy price increases relative to labor and other inputs justified a radical retooling, long lead times would be required to change agriculture's technological configuration. Further, the pattern of land ownership and tenancy developed during the last century is not adaptable to labor-intensive production, except for limited acreages of high-value specialty crops.

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[8] Pavelis examines the effects of three factors—energy in the form of electricity and petroleum fuels, public investment in conservation and natural resources, and expenditures for agricultural research and expansion—on total farm output and efficiency [20]. Results indicate that energy use in agriculture was associated with about 6 percent of the increase in agricultural output and 15 percent of the increase in productivity from 1929 to 1972. Farm energy use in this study, however, is narrowly defined to exclude the energy component of fertilizers, pesticides, and farm machinery. The use of these energy-intensive inputs has increased substantially during this period, and their impacts on output and productivity possibly are concealed in other variables.

This is not a defense of current or past food system practices, but rather an appraisal of agriculture's expected response to changing price relationships. As energy prices increase, marginal adjustments toward energy-saving technologies can be expected. Society should not expect large absolute savings in energy use at the farm level, however, given the small proportion of total energy consumed there.

Energy Prices and Spatial Competition

• The competitive position of a region or country in the production of a particular commodity may improve or deteriorate as a result of increased energy costs. Casavant and Whittlesey [5] identify commodity and regional characteristics that determine the impact of higher energy-related transportation costs on interregional and international competition. Commodity factors include perishability, product value relative to weight, transportation mode adaptability, extent and location of processing, and elasticity of demand. Regional characteristics affecting competitive position include distance to (domestic or export) markets, available transport alternatives, backhaul possibilities, and seasonality of product movements.

Industry infrastructures and institutional factors must also be considered in assessing the impact of changing energy prices on the location of agricultural production. For example, during the last 30 years, low-cost energy has provided market and public policy incentives that deemphasized the use of railroads in the U. S. transportation sector. Although rail shipment of agricultural commodities is more energy-efficient than trucks or barges, even an immediate policy decision to improve rail transport facilities and services would require a lengthy time period for implementation.

International competition and trade are influenced even more by government policies and other institutional barriers than are U. S. interregional patterns. Tariff and non-tariff barriers of the EEC, for example, are designed to protect farmers there from world market competition. Legislation requiring that U. S. export commodities be shipped in domestic-built bottoms impairs transportation efficiency. Comparative advantage *per se* is allowed to determine world production and trade patterns for very few commodities. Given the impact of energy prices on world inflation and monetary instability, trade protectionism may intensify.

Recently it has been argued that U. S. agricultural production is energy-inefficient relative to more primitive labor-intensive systems [21]. The implication is that the U. S. may lose some of its comparative (and absolute) advantage in producing farm products for world markets under higher energy prices. This contention is fallacious for several reasons. But to note two: it considers the cost of only one input (energy), whereas comparative advantage involves total production costs; and most farmers in labor-intensive food-production systems produce food mainly for their family needs, precluding them as viable competitors in world markets.

Energy and the World Food Situation

The international dimensions of the food system suggest important policy implications. In fact world food supplies relative to economic demand and nutritional requirements present an "energy crisis" with more direct human ramifications than the fossil fuel situation.

A recent University of California study [36] projected world food production and utilization to 1985. Substantial deficits of cereals, animal products, and oilseeds are projected in Asia, Africa, and Latin America. Projected surplus cereal production in North America and Oceania should be capable of overcoming the large deficits of the developing regions, provided that the developing regions have the monetary resources to purchase the grain and/or the developed countries are willing to provide it on a concessional basis. However, it seems unlikely that the developing countries will have the resources to pay for such an enormous amount of grain considering, among other problems, increased energy costs. Conservatively estimated, the cereal shortfall for developing nations in 1985 could cost over $15 billion (in current prices). Exports of some commodities (e.g., cocoa and coffee) by developing countries are certain to generate foreign exchange, but not at the levels necessary to pay for all required cereal imports.

These vast differences in human food supply between world regions emphasize the crucial role of the advanced nations in the formulation of trade, aid, and food reserve policies. As major participants in agricultural trade, the developed countries lead in the formulation of world trade policies. If current trade negotiations result in increased protectionism, many developing countries could be adversely affected.

The issue of food reserves, which is of considerable concern in light of depleted world grain stocks, assumes even greater importance because of world economic uncertainty and volatility related to energy price increases. This issue is particularly important to the U. S. as the principal world producer and exporter of grain.

The types of aid programs extended to developing nations are another important policy issue. Direct food aid, a useful short-run device for dealing with catastrophic crop failures, should only supplement longer-run programs to increase domestic food production. Adaptive research should place higher priority on the genetic development of pest-resistant crops, to reduce reliance of developing nations on energy-intensive manufactured inputs while simultaneously increasing food output.

Agricultural price and income policy

Current U. S. farm policy must be assessed in the light of recent energy price impacts on the world economy. Considerable uncertainty faces U. S. export demand as a result of energy-induced inflation, international payments, and economic growth problems. This uncertainty comes at a time when federal farm policy is encouraging increased food and fiber production in response to expected strong domestic and world markets for U. S. agricultural products. If the export demand contraction now occurring for certain specialty crops should become more widespread, depressed farm product prices, combined with cost-push inflation of farm production costs, could substantially reduce net farm incomes.

The movement away from price supports and acreage allotments in the 1973 Agricultural Act could also result in more volatility in agricultural prices and incomes. Target prices do not lend the same degree of stability to the farm sector; indeed, the 1973 Act was intended to have more market orientation than previous agricultural legislation. However, the 1973 Act does provide for reimposition of acreage allotments if that option becomes economically and politically justifiable. Inflation's impact on farm production costs will also increase target prices under the escalator provision in the 1973 Act.

Distribution Effects of Energy Prices

Energy-induced inflation affects income and wealth distribution within the national economy and within the food system. Few studies to document these effects are available. Roberts [26] points out that lower-income households spend a higher proportion directly on energy, contributing to inequality of real income distribution. To the extent that *indirect* impacts of higher energy prices increase the prices of other necessities, income maldistribution is further compounded. The combined contribution of energy and food prices to U. S. inflation in 1973 (discussed above) illustrates this distributional impact. Energy pricing policies should explicitly take into account distribution effects.

Within the food system, the impacts of energy prices on income and wealth distribution depend on a particular sector's ability to pass on the higher direct and indirect costs to the next sector. Marketing margins tend to expand during inflationary periods, widening the difference between retail prices and farm prices. A firm's debt position and relative operating efficiency also affect its ability to withstand energy price increases.

Tweeter and Quance estimated the impact of input price changes on U. S. farm costs and revenues from 1958 to 1967 [33]. Under those assumptions they considered most reasonable, the authors concluded that farmers are disadvantaged by input price inflation, with the impact varying by input. For factors with elastic demands (e.g., fertilizer), inflation may enhance net returns, at least for those commodities with relatively inelastic output demand functions. On the other hand, price inflation for inelastic factors (real estate, labor, and other durable inputs) increases costs more than gross revenues, depressing net farm incomes. A more complete assessment of inflationary impacts (from energy price increases or other sources) on agriculture must consider the differential impacts on the net income and wealth positions of farms by size, region, and commodity group.[9]

Brandow [3] analyzed the distributional impacts of U. S. inflation within the agricultural production sector. Based on 1953–1970 data, he found that farm prices rose more than the Consumer Price Index and that inflation increased meat animal and poultry prices more than fruit and vegetable prices. Brandow also concluded that inflationary increases in purchased farm inputs had a negative impact on real net farm incomes; that inflation enhances the incomes of commercial family farm owners and hired farm labor the most; tenants the least; and that the wealth position of larger farm owners with a high proportion of assets in real estate increases the most during inflationary periods.

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[9] Some excellent groundwork has been laid for this type of research by Boyne [2], Bryant [4], Grove [10], Hoover [13], Johnson [16], and Tweeten and Nelson [32].

The data studied by Brandow included periods of both demand-pull and cost-push inflation and substantial variations in federal farm policies. Although current inflation is more clearly of a cost-push nature, many of the distributional impacts are the same. We agree with Brandow's point that a nearly pure cost-push inflation "will be [more] damaging to [production] agriculture" than demand-pull inflation. Thus, the policy implications of current energy-stimulated inflation have more serious ramifications for U. S. agriculture than previous demand-induced price increases.

Energy, Technology, Prices, and Environmental Concerns

The energy policy debate is like a re-run of the same dialogue centering on environmental concerns, referred to earlier as the second wave since World War II. The no-growth proponents espouse a return to a Jeffersonian nation of small farmers who generate all their power from windmills or solar sources in closed systems. At the other extreme are the technocrats advocating the development of backstop technology, such as breeder reactors using U^{238} fuel. World reserves of U^{238} are projected to provide energy for over a million years at current consumption rates. Robert Solow quips that "if that is not a backstop technology, it is at least a catcher who will not allow a lot of passed balls" [29, p. 4].

But alternatives do exist between the extremes of a "bio-ecological equilibrium" and blind faith that a backstop technology will emerge. Technical efforts can be redirected toward reducing both environmental stress and exploitation of exhaustible resources, although these two goals may at times be competitive. The literature on induced technological change states that when price ratios vary, firms may rationally allocate resources to develop new technical opportunities which will facilitate the substitution of increasingly less expensive factors for more costly ones [11].

Solow, in his Richard T. Ely Lecture, reminded us of the 1931 writings of Harold Hotelling on the subject of "The Economics of Exhaustible Resources" [14]. Hotelling's comment bears repeating: "Contemplation of the world's disappearing supplies of minerals, forests and other exhaustible assets has led to demands for regulation of their exploitation. The feeling that these products are now too cheap for the good of future generations, that they are being selfishly exploited at too rapid a rate, and that in consequence of their excessive cheapness they are being produced and consumed wastefully, has given rise to the conservation movement." Solow succinctly summarized the fundamental principles of the economics of exhaustible resources: If net price is increasing like compound interest, owners will be indifferent at the margin between extracting and holding at every instant of time. If the net price were to rise too slowly, production would be accelerated and exhausted quickly, because it would be uneconomical to hold resources in the ground and earn less than the going rate of return. Conversely, if prices were to rise too fast, owners could delay production and enjoy high capital gains [29].

If we accept Hotelling's contention that energy prices are too cheap, the higher energy prices accomplished by an international cartel or other means may be to society's long-run advantage, provided the adjustments and distributional impacts are not too sudden or severe. Certainly higher energy prices should stimulate exploration for new oil and natural gas reserves; lead to shifts toward alternative sources of energy; dampen energy use through factor substitution and reduced economic growth; and hasten development of energy-saving technology, as economic theory suggests.

But concern has been expressed that some of these expected results from higher energy prices will be detrimental in meeting society's environmental improvement goals. The concern is real. Some recent policy decisions apparently capitalized on public concern about oil shortages during the Arab boycott. Delays in automobile emission control regulations, resumption of off-shore drilling, and initiation of the Alaskan pipeline project are examples. Yet for every competitive aspect of the energy-environment situation, one can cite complementarities: the trend toward smaller automobiles, household energy conservation practices, and use of mass transit. Examples also occur in agriculture: reduced tillage methods, balanced cultural practices that require less commercial fertilizer and pesticides, and more efficiently-scaled farm machinery.

Also, as the direct and indirect impacts of higher energy prices increase costs of production inputs, the push toward greater efficiency may result in more utilization and recycling of by-products and "wastes." For example, poultry and livestock producers are showing considerable interest in methods of recycling manure for feed and for generating methane gas.

Thus, the emergence of the most recent energy crisis has brought into clearer focus the trade-offs as well as the complementarities of natural resource development and environmental goals. Now that the concepts are more evident, the absence of reliable data and analysis for measurement becomes obvious. Options between safety and cost, between current consumption and future consumption, and between consumption levels and costs are complex and multidisciplinary. Landsberg [18] summarizes these broad issues into two questions: How can we agree on the point up to which we wish to trade additional, or lower cost, energy for environmental quality? And in what proportion will different groups in society share the costs that inevitably flow from trade-off decisions? The latter point will affect agricultural producers most directly.

Concluding Comments

The wide range of issues discussed in this paper illustrates the pervasive impact of energy price increases on the U. S. and world food systems. We have argued that the major energy issues facing U. S. agriculture are more price-related than supply-related, and that the indirect effects of higher energy prices have more long-run significance than the direct ones. Indeed, American agriculture may simultaneously face farm product prices depressed below current levels and cost-push inflation of factor prices when the direct and indirect impacts of energy price rises materialize.

Within the U. S. food system, energy-saving potentials are greater off the farm than in the production sector, but higher prices are likely to encourage conservation practices in all sectors as long as price ratios between energy and other inputs warrant it. We do not anticipate that U. S. agricultural production will become much more labor-intensive as a result of energy price increases, or that primitive world food production systems will become major exporters of food commodities.

Both developed and developing nations are affected by world adjustments to changing energy prices. The demand for U. S. agricultural products in other industrial countries will be adversely affected by inflation, balance of payments problems, and depressed economic growth rates. While developing economies will experience varying degrees of energy price impact, all but the oil-exporters will be adversely affected. Some less developed nations will find their agricultural development programs thwarted by higher energy prices, compounding existing food shortages.

Most of the direct and indirect energy-price impacts discussed in this paper should be regarded as hypotheses rather than conclusions. While we have few numbers to document our views, numerous energy-related applied economic research topics are evident. Some direct impacts of energy prices on farm production costs have been analyzed, but very few studies of indirect energy implications for inflation, economic growth rates, spatial competition, income distribution, and environmental quality have been reported. We hope our professional colleagues will consider some of these topics as they ponder future research priorities.

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Session 1

ENERGY AND U. S. AGRICULTURE

CHAIRMAN: MAX R. LANGHAM, UNIVERSITY OF FLORIDA

Petroleum for U. S. Agriculture

ROBERT R. WILSON

THE 1970s AND '80s have been recognized by many as an era of raw material commodity shortages. The optimism of the 1950s and 1960s that technological advance would ameliorate the alleged paucity of resources on the planet has not been realized in the 1970s. The growthmen and technological fundamentalists have been replaced with quixotics who tilt with the windmills of environmental and commodity crises. The quixotics, of course, also tilt among themselves whenever windmills are scarce. Many feel that public and private investments in technology have not kept pace with the need while others feel that seeking the bonanza in advanced technology may result in just another dry hole.

During the past year critical shortages and/or substantial fluctuations in prices have occurred in tin, pig iron, lead, zinc, mercury, antimony, tungsten, silver, magnesium, bismuth, palladium, gold, phosphate, coal, petroleum, and petroleum products. Each of these commodities has experienced a price change of more than 50 percent during the past 12 months [22]. Serious shortages of natural gas are expected to occur again this year, and a scheduled national coal strike could have a more substantial impact on energy supplies this fall and winter than the Arab oil embargo of the previous year.

During the last eighteen months fossil fuels have experienced at least a doubling in price. The average prices of petroleum products have more than doubled. During the past winter, spot prices of oil reached levels of more than four times their magnitudes of 18 to 24 months ago.

Imports of these critical commodities constitute a significant component of U. S. consumption, and most may be subject to actions of international cartels seeking political or monetary gains. The recent Arab oil embargo is sometimes recognized to be an international cartel action to achieve both political and monetary concessions.

The Energy Crisis and the Arab Oil Embargo

The recent energy crisis was apparently a case in which the dynamic market mechanisms failed to attract a level of investment in new domestic petroleum discoveries and refinery capacity sufficient to maintain a relatively stable relationship between domestic consumption and production. There are basically two reasons for this: (1) *governmental policies* of regulating prices of natural gas, and more recently, oil and finished products taxation that encouraged overseas rather than domestic development; restrictive leasing of lands under federal jurisdiction for oil and gas development; limited efforts in research and development for finding and extracting oil and gas resources; and uncertain and indecisive environmental policies; all of which restricted domestic supplies; (2) *declining domestic real prices.* Domestic real prices of both crude petroleum and finished petroleum products had declined over the period from World War II to 1972 because of competition from lower priced imported products. As a result of the stable low prices, demands for energy in the United States grew at a phenomenal rate in recent years. By autumn of 1973 the U. S. was importing about 36 percent of its petroleum consumption [4]. Much of the imported petroleum came from Arab countries, and domestic crude petroleum production had begun to decline.

Throughout 1973 there was a growing apprehension that the U. S. might be able neither to produce nor to import enough petroleum products at existing market prices to avert a major disaster during the winter of 1973–74. There had long been discontent about low petroleum prices among the members of the Organization of Petroleum Exporting Countries. The October

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1973 Mid-East War precipitated increasing pressures for political sanctions against the U. S. The resultant Arab oil embargo compounded an existing energy crisis in the U. S.

Prices of crude petroleum and products rose rapidly during the months of the Arab embargo. Domestically, prices have stabilized at around double their levels of a year ago [22].

There is evidence that a market clearing solution has been reached. There are now reports that prices of petroleum products in the U. S., particularly gasoline, have fallen slightly from their levels in June 1974 [22]. In addition, the Treasury Department has estimated an international oil surplus of 1.5 to 2 million barrels per day at current prices.[1] The American Petroleum Institute has reported 7745 new oil and gas well completions in the U. S. during the second quarter of 1974, an increase of 34.2 percent over the second quarter of 1973, foretelling increased domestic supplies of crude oil.

Supplies of petroleum products are expected to meet demands during the remainder of 1974 and possibly into 1975, provided that no new embargo or similar action occurs and limited conservation and price induced changes in demand prevail [6]. An extended coal strike in the fall of 1974 could cause serious shortages in the industrial sector and in electric power generation. Steel production could be substantially affected by a strike of more than 30 days, and electric power shortages are expected with a slightly longer strike.

From the market disequilibrium standpoint the petroleum component of the energy crisis would appear to be solved.[2] The market solution is highly dependent, however, on imports of foreign oil, which leaves the market strategically vulnerable to international cartel actions including oil interruptions or price increases.

In the next sections, U. S. demands for petroleum products of importance to the agricultural sector and agricultural demands for these products will be considered.

F.E.A. Petroleum Forecasting Equations

In late 1973 after the imposition of the Arab oil embargo it became desirable for the Federal Energy Office to develop monthly forecasting relationships with which to predict shortages of major petroleum products. The author was assigned to develop several of these relationships including forecasting equations for motor gasoline, aviation gasoline, and liquefied petroleum gases. These relationships covered the major areas of agricultural demand with the exception of diesel fuel which was classified under the distillate oil demand in the F.E.O. forecasting model.[3]

The forecasting equations are assumed to be reduced form equations of market consumption. No hypotheses about the structure of supply and demand are suggested. Though price appears in the motor gasoline equation, it was assumed that price was an exogenous variable in the short run. All consumption data were taken from monthly petroleum statements of the Bureau of Mines. Although these relationships were developed in an on-rush of a great crisis in November and December of 1973 and subject to massive subsequent improvements, they remained the official short term forecasting instruments of the Federal Energy Administration throughout the oil embargo and past mid-summer of 1974.

The forecasting equations

The forecasting equations are as follows:

1. *Motor Gasoline:* The forecasts of the annual domestic demand for motor gasoline are based on the following monthly equation:

$$
\begin{aligned}
DMG = {} & \underset{(5.26)^{4}}{59.418} \quad \underset{(-2.71)}{-114.69 * PMG} \\
& + \underset{(5.88)}{.00095993 * PY} \\
& \underset{(-4.03)}{-.011088 * \mathrm{DD}} \\
& - \underset{(-1.93)}{4.2310 * S02} + \underset{(1.50)}{2.5410 * S03} \\
& - \underset{(-2.44)}{5.0821 * S09} + \underset{(2.04)}{4.8020 * S12} \\
& + \underset{(+4.69)}{.51089 * DMG\ (-12)} \\
& \underset{(2.73)}{(RHOG^{K1}) * (GACT - GSTAR)}
\end{aligned}
$$

$R^{-2} = .9660$; $DW = 2.1666$; $SE = 3.88266$ $RHOG = 0.312165$; where $DMG \equiv$ domestic demand for motor gasoline, millions of barrels per month, $PMG \equiv$ monthly average price (in dollars per gallon) at 55 cities for major brand-name, regular gasoline excluding taxes; $PY \equiv$ monthly total personal income in millions of current dollars, $DD \equiv$ national monthly degree days; $GACT \equiv$ actual domestic monthly total demand for motor gasoline in July 1973; $GSTAR \equiv$ the forecast from the above equation omitting $(RHOG^{K1}) * (GACT - GSTAR)$ for July 1973; $K1 = 6, 7, \ldots, 17$ for January through December respectively; $S02$, $S03$, $S09$, and $S12$ are seasonal dummy variables for February, March, September, and December respectively; DMG was obtained from the Bureau of Mines Monthly Petroleum statements [1]; PMG was obtained from Data Resources Inc.; and PY was obtained from the McGraw-Hill Survey of Personal Income [14].

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[1] This estimate was for July 1974. By September 1974 the estimated international oil surplus had doubled, but several OPEC countries announced output reductions by a total of about 1.5 million barrels per day, accompanied by price increases.

[2] Balance of payments and international financial problems may become almost as critical as energy shortfalls.

[3] The distillate oil equation was developed by Dr Frank J. Alessio. These relationships were reported in detail in [6].

[4] The numbers in parentheses are *t* statistics.

2. *Aviation Gasoline:* The forecasts of the annual domestic demand for aviation gasoline are based on the following monthly equation:

$$\begin{aligned} DAG = {} & 8.0027 + .00004409 * PY \\ & (4.43) \qquad\quad (2.02) \\ & - .00027596 * DD \\ & \qquad (-3.60) \\ & - 0.03409 * T \\ & \qquad (-3.21) \\ & + .31531 * DAG\ (-12) \\ & \qquad (3.18) \end{aligned}$$

$R^{-2} = .8733$; $DW = 1.80$; $SE = .252689$;

where $DAG \equiv$ domestic total demand for aviation gasoline, millions of barrels per month, $T \equiv$ a linear time trend and the remaining variables as defined above. DAG was obtained from the Bureau of Mines Monthly Petroleum Statements [1].

3. *Distillate Oil:* The forecasts of the annual demand for distillate fuel oil are based on the following monthly equation:

$$\begin{aligned} DDO = {} & 12.294 + .00036228 * PY \\ & (6.93) \qquad\quad (10.13) \\ & + 0.0000000033 * BNT * DD \\ & \qquad\qquad (12.65) \\ & + .30357 * DDO\ (-12) \\ & \qquad (5.52) \end{aligned}$$

$R^{-2} = .9739$; $DW = 1.8901$; $SE = 3.64352$; where $DDO =$ domestic total demand for distillate fuel oil, millions of barrels per month, $BNT \equiv$ number of oil burner tips in use at end of month, and the remaining variables as defined above. DDO was obtained from the Bureau of Mines Monthly Petroleum Statements [1], and BNT was obtained from Fuel Oil and Oil Heat Magazine [10].

4. *Liquefied Petroleum Gases:* The forecasts of the annual domestic demand for liquefied petroleum gases are based on the following monthly equation:

$$\begin{aligned} LG = {} & -1.0417 + .0060598 * DD \\ & (-0.30) \qquad\quad (4.11) \\ & + 7.1578 * FRBC \\ & \quad (2.52) \\ & + .68081 * DLG\ (-12) \\ & \quad (7.61) \\ & - (RHOLG^{K2}) * (LGACT - LGSTAR) \\ & \qquad (5.65) \end{aligned}$$

$R^{-2} = .9254$; $DW = 2.0077$; $SE = 2.0528$; $RHOLG = .54556$; where $LG \equiv$ domestic total demand for liquefied gases, millions of barrels per month; $FRBC \equiv FRB$ production index of chemicals and products; $DLG\ (-12) \equiv$ domestic total demand for liquefied gases, lagged 12 months; $LGACT \equiv$ actual domestic monthly demand for liquefied gases in September 1973; $LGSTAR \equiv$ the forecast from the above equation omitting $(RHOLG^{K2}) * (LGACT - LGSTAR)$ for September 1973; $K2 = 4, 5, \ldots, 15$ for January through December 1974 respectively. DLG was obtained from the Bureau of Mines Monthly Petroleum Statements [1], and $FRBC$ was obtained from the Federal Reserve Bulletin [9].

The aviation gasoline and distillate oil equations were estimated using ordinary least squares. The motor gasoline and liquefied petroleum gases equations were estimated using the Cochrane-Orcutt method for a first order autoregressive process [13]. By extending a result given in Johnston [13], it can be shown that the statement of the autoregressive equations given provides best linear unbiased forecasts.

The reporting of t statistics rather than standard errors is subject to criticism. Generally, the exact distribution of least squares parameter estimates from distributed lag or autoregressive models is not known. In addition, if the price in the motor gasoline equation is truly endogenous, then the parameter estimates in the gasoline equation are not consistent.

Forecasts of Petroleum Consumption

Forecasts of U. S. consumption during 1974 and 1975 of motor gasoline, aviation gasoline, distillate oil, and liquefied petroleum gases were based on the F.E.A. short term forecasting equations.[5] Agricultural consumption for these products was forecast using methods developed during a study of end use demands for petroleum products conducted for F.E.A. [21] and modified as noted in the following sections.

Motor gasoline

Forecasts of U. S. total consumption of motor gasoline were based on the April 26, 1974 unconstrained F.E.A. forecasts adjusted for changes in prices [6]. The F.E.A. forecasts assumed a constant average price of 30 cents per gallon exclusive of taxes throughout 1974 (Table 1). The prices employed in the present forecast were the actual average prices—39 cents, 41 cents, and 43.5 cents per gallon for the first and second quarters and July 1974. The 43.5 cent price was assumed to prevail for the remainder of 1974 and 1975. By late July 1974 prices were reported to be falling slightly [22]. The present forecast is also given in Table 1. Consumption in 1974 is forecast at 2,391 million barrels and in 1975 at 2,446 million barrels, the difference arising from growth in personal income similar to that in 1974 [2].

The apparent price effect is the difference between the actual price in the period and the 30 cent pre-embargo price assumed in the F.E.O. unconstrained demand forecast, weighted with the price coefficient from the equation, converted to thousands of barrels per day. During the first two quarters of 1974, mandatory conservation, including reduced speed limits, long lines, and uncertainty about the availability of gasoline apparently accounted for considerable reductions in demand [7]. There is considerable risk in interpreting the price coefficient as representing a price effect since the forecasting equation does not represent a structural demand hypothesis, and the data are extrapolated far beyond the range of estimation. It would appear that in the July 1974 forecast the apparent price effect is overstated because some mandatory conservation measures (lowered speed limits) still exist, but there is no separable conservation effect [8].

Although the motor gasoline equation is not structural, price elasticity estimates were developed. At the end of the data series for estimation (July 1973) the price was 26.78 cents per gallon and consumption was about 7100 barrels per day. The short and long run price elasticity estimates in July 1973 were —.140 and —.285, respectively. Extrapolating the price coefficient well beyond the range of the data, the short and long run price elasticity estimates in July 1974 were —.237 and —.485, respectively. Structural relationships, however, should be developed covering more recent data with substantial price changes for reliable estimation of price elasticities.

Agricultural consumption of motor gasoline was forecast for 1974 and 1975 based on the total motor gasoline consumption forecasts for the period and a study of end use demands for all petroleum products prepared for F.E.A. [21]. These forecasts of agricultural consumption of motor gasoline along with an unpublished 1974 forecast by the U. S. Department of Agriculture are given in Table 2. In that study it was estimated that 3.1 percent of total motor gasoline consumption was for off-highway purposes. This would imply off-highway consumption of 203 thousand barrels per day or 74 million barrels

Table 1. Motor gasoline consumption and forecasts—1974 and 1975

	Forecast					
	FEO Unconstrained Pre-Embargo	Present Analysis	Apparent Consumption	FEO Forecast Less Apparent Consumption[a]	Apparent Price Effect	Apparent Conservation Effect
1974			Thousands of Barrels per Day			
QTR						
I	6500	6100	5800	700	400	300
II	7100	6700	6500	600	400	200
July	7300	6800	6800	500	500	0
III	7300	6800			500	
IV	7100	6600			500	
1974 Annual	7000	6550 2391 million barrels				
1975 Annual		6700 2446 million barrels				

[a] As reported by F.E.A. in [7, 8].

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[5] The F.E.A. short term forecasts were revised in August 1974 after this paper was prepared [5].

per year for 1974. For 1975 off-highway consumption is forecast at 208 thousand barrels per day or 76 million barrels per year.

Agricultural consumption of motor gasoline for off-highway use was estimated at 60 percent of total off-highway consumption, based on Federal Highway Administration tax refund data [18]. The 60 percent figure implies forecast agricultural consumption for which tax refunds were claimed of 122 thousand barrels per day or 45 million barrels per year in 1974 and in 1975, 125 thousand barrels per day or 46 million barrels per year.

Based on unpublished results of the 1971 Farm Expenditure Survey, some 54.9 percent of motor gasoline purchases by farmers were delivered to the farm [17]. The remaining 45.1 percent was purchased at service stations. Assuming that only 54.9 percent of farm use of motor gasoline was claimed for tax exemptions, the forecasts of agricultural consumption become 222 thousand barrels per day, or 81 million barrels for 1974 and 228 thousand barrels per day, or 84 million for 1975.

Aviation gasoline

The F.E.A. forecasting relationship yielded 31, 40, 40, and 36 thousand barrels per day for the first, second, third, and fourth quarters of 1974, respectively, or an average of 36.75 thousand barrels per day [6]. Extrapolating the same increase in personal income in 1975 as forecast for 1974 [2] and accounting for the time trend, the forecast average daily consumption for 1975 is 37.65 thousand barrels per day. Annual forecasts of consumption of aviation gasoline are 13.4 million barrels and 13.7 million barrels for 1974 and 1975.

The 1975 figure would imply a reversal in the downward trend in aviation gasoline consumption as evidenced in the data for the past several years. Since there would appear to be no circumstance to warrant an increase, the 1975 forecast should be treated with caution and the forecasting relationship re-estimated using more recent data.

Based on the F.E.A. end use study [21], business and personal use of aviation gasoline is about 28.4 percent of total aviation gasoline consumption. Forecasts for the business and personal use categories for 1974 and 1975 are 3.8 and 3.9 million barrels, respectively.

Agricultural use of aviation gasoline in 1971 was 920 thousand barrels [11]. Based on a 3 percent long term growth rate in agricultural use, agricultural use of aviation gasoline is forecasted at about 1 million barrels both for 1974 and 1975, or about 25 percent of business and personal use (Table 2).

Table 2. Forecast agricultural consumption of petroleum products

Product	1974 Forecast Present	1974 Forecast USDA*	1975 Present Forecast
	(Million Barrels Per Year)		
1. Motor Gasoline	81	95	84
2. Aviation Gasoline	1	—	1
3. Diesel Fuel	51	66	61
4. L. P. Gas	18	36	19

* Unpublished forecasts of the U. S. Department of Agriculture [16].

Distillate oil and diesel fuel

Based on the F.E.A. forecasting relationships [6], total U. S. demand for distillate oil in 1974 is forecasted at 4366, 2513, 2345, and 3551 thousand barrels per day. For July 1974 apparent consumption was 2247 thousand barrels per day, 42 thousand barrels per day higher than the F.E.A. forecast.

It is significant that the F.E.A. forecasting relationships and unconstrained forecasts are based on time series ending in January 1972. Prices of distillate oil have increased more than 100 percent at wholesale during the subsequent 19 months. Consumption does not appear to be highly sensitive to price effects.

Based on this apparent lack of price sensitivity, and on largely voluntary conservation effects, the 1974 F.E.A. unconstrained consumption forecast of 3190 thousand barrels per day, or 1164 million barrels, was assumed. The effect of a change in numbers of burner tips of the magnitude of the 1973 to 1974 change is forecast to change consumption by less than a thousand barrels per day. A constant rate of growth in income over the 1973–1975 period implies an increase in the consumption forecast for 1975 over 1974 by 634 thousand barrels per day, to 3824 thousand barrels per day [2]. Annually, such a 1975 forecast would amount to 1396 million barrels.

Agricultural consumption of distillate oil is a portion of off-highway diesel use. Off-highway diesel use was projected at 4.4 percent of the total consumption of distillate oil in the F.E.A. study of end uses of petroleum [21]. Applying this fraction to the 1974 and 1975 consumption forecasts, off-highway use of diesel is forecast at 51.2 million barrels in 1974 and 61.4 million barrels in 1975. The off-highway portion of distillate oil demand was based on Bureau of Mines sales survey data [21].

The U. S. Department of Agriculture put 1973 farm use of diesel fuel at 60 million barrels and forecast a 66 million barrel usage in 1974. Both figures exceed the F.E.A. off-highway diesel use estimate. In this paper it is assumed that the 51 million barrels for 1974 and the 61.4 million barrels for 1975 of off-highway diesel consumption constitute agricultural consumption (Table 2).

Liquefied petroleum gases

The unconstrained F.E.A. forecast of consumption of liquefied petroleum gas was adopted in the present analysis [6]. This forecast is 1556, 1041, 1018, and 1508 thousand barrels during the first, second, third, and fourth quarters of 1974, or an average of 1281 thousand barrels per day. Based on a Data Resources Inc. forecast of the growth in the Federal Reserve Board Index of Chemicals and Products of .173 points for 1975 [2, 9], the 1975 forecast of consumption of liquefied petroleum gases is 1302 thousand barrels per day. The forecasts of annual liquefied petroleum gas consumption for 1974 and 1975 are 468 and 475 million barrels, respectively.

Based on the F.E.A. end use demand study [21], agricultural use of liquefied petroleum gases falls into the end use categories of internal combustion engines and in other uses. According to the Bureau of Mines sales survey definitions, it is assumed that all of the other use category is agricultural [21]. Based on 1.8 percent of total liquefied gas consumption from the F.E.A. end use study, 8.4 million barrels of other (agricultural) use is forecast for 1974. By applying the 1.8 percent to the 1975 forecast, a consumption of 8.6 million barrels is forecast for other use in 1975. The U. S. Department of Agriculture estimated that 1973 use of liquefied petroleum gases for drying corn and tobacco totaled 18.6 million barrels. Based on the 1971 Farm Production Expenditure Survey, 46 percent of agricultural use was other uses [15]. Applying the 46 percent figure to the 8.4 and 8.6 million barrel figures, total agricultural consumption forecasts would be 18.3 and 18.7 million barrels in 1974 and 1975, respectively (Table 2).

Agricultural production use was forecast as 35.7 million barrels by the U. S. Department of Agriculture for 1974. Total consumption on farms including home heating should total more than 70 million barrels in 1974 based on a 1971 figure of 55 percent of farm use as home heating [15]. The comparison of U. S. Department of Agriculture and Bureau of Mines based data on agricultural consumption implies serious discrepancies between the two data sources. Doubt is cast that meaningful forecasts of agricultural consumption of liquefied petroleum gases can be based on the F.E.A. end use demand study and the Bureau of Mines sales survey [21].

Other energy consumption

Gavett [11] reports that the fertilizer industry consumes about 2 percent of the U. S. natural gas consumption or about 375 billion cubic feet on an annual basis. Most of the natural gas, 325 billion cubic feet, is used in the production of ammonia, the remainder being used in the drying of other fertilizer elements.

Gavett also estimates that around 40 billion kilowatt hours are consumed on farms, or about 2 percent of the total. About 15 percent of this electric power, nationally, is generated with petroleum. In addition an estimated 81 million barrels of diesel fuel and 9 million barrels of gasoline are used to move agricultural products to markets [11].

In 1974 U. S. petroleum consumption is expected to be around 6.2 billion barrels of oil [6]. Agricultural consumption of petroleum will total around 260 million barrels, including transport to market. Thus agriculture is expected to consume around 4 percent of U. S. petroleum in 1974 and 1975. Beyond 1975 growth rates of agricultural consumption of petroleum are not expected to exceed 2 or 3 percent in the absence of substantial changes in agricultural technology or demands for agricultural products.

Future U. S. Petroleum Supplies

Domestic production of crude petroleum reached an all time peak of 9.8 million barrels per day in April 1971 and has declined since that time except for limited oscillations. Imports of crude oil reached a peak level of 3.8 million barrels in October of 1973, dropped sharply during the Arab oil embargo, and had almost resumed their previous peak levels by May of 1974 [4]. Imports of finished petroleum products peaked in February 1973 at 3.6 million barrels per day and were at 3.0 million barrels per day in May 1974 [4].

The U. S. has only two options if it is to satisfy its petroleum demands at existing prices: supplies of petroleum can be either produced domestically or imported. If domestic supplies can be encouraged by public policies at costs less than world market prices, then downward pressure will be exerted on both world and domestic energy prices.

Existing productive capacity is relatively fixed, but can be changed somewhat in the future by favorable market prices and public policies. According to the latest estimates of the Geological Survey [20], the sum of measured and inferred reserves ranges from 62.7 to 79.2 billion barrels for the onshore coterminous states and Alaska. Offshore measured and inferred reserves range from 10.6 to 14.1 billion barrels. Except for the Gulf of Mexico and offshore California areas, the offshore areas are essentially unexplored. Total cumulative production to the present time has been about 120 billion barrels for the U. S. Thus, more than half of all measured and inferred reserves ever discovered in the U. S. have been produced.

The Geological Survey also estimates that from 135 to 270 billion barrels of undiscovered recoverable resources (not necessarily economically producible) remain in Alaska and coterminous states onshore. An additional 65 to 130 billion barrels of undiscovered recoverable resources are estimated for the offshore areas. These undiscovered recoverable resources of 200 to 400 billion barrels are inferred from seismic and other geological and geophysical data and are not, of course, based on exploratory drilling. The offshore areas, particularly, have received little exploration.[6]

If the Geological Survey estimates are correct, there is from two to four times as much petroleum remaining to be produced in the U. S. as has been produced to date. The oil industry has challenged the Geological Survey estimates indicating that they may be two to five times too high, with most of the remaining undiscovered recoverable oil in the offshore areas [12].

Newly discovered oil now brings a market price of between $10 and $11 per barrel in the U. S. Economic costs of exploration, development, and producing new oil are escalating rapidly because of the increased demand for oil field equipment and manpower at oil prices triple those of two years ago. At rates of return of 10 to 15 percent, the oil industry may not find it attractive to explore and develop much of the small and difficult to find onshore resources estimated by the Geological Survey. In the offshore areas exploration, development, and production costs are much greater than onshore, particularly for offshore Alaska. Oil in some areas might not be producible at real prices per barrel under $30, an order of magnitude greater than 1972 prices. On the other hand, the best offshore areas in the Atlantic Ocean and offshore Alaska might be able to yield oil for $2 to $3 per barrel. Lead times for the development and production of these resources is more than 10 years in many cases. The magnitude of the remaining resources and the prices at which such resources could be developed are highly uncertain at the present time. These uncertainties make any plans currently being laid to achieve energy independence at some future date highly speculative at best.[7]

At new crude oil prices of more than $10 per barrel there are also rather open-ended possibilities for the production of synthetic crude oil from tar sands, oilshale, and coal. Estimated threshold prices for the development of synthetic crudes range from $7 to $9 per barrel according to unpublished information from the Bureau of Mines. Lead times are again in the neighborhood of 10 years before such petroleum can become available.

Given the lead times required to develop new natural and synthetic petroleum resources, there are severe limitations on the ability of the U. S. to increase its domestic supply of petroleum in the near future. It would appear that it will be necessary for the U. S. to rely heavily on imports of petroleum for the next several years.

Conclusions

The consumption of energy in the U. S. has been growing at from 3 to 4 percent per year [3, 17] with growth in petroleum consumption at around 5 percent per year [6]. The consumption of motor gasoline, aviation gasoline, distillate oil, and liquefied petroleum gases for the U. S. and for the U. S. agricultural sector was forecast for 1974 and 1975. Agricultural consumption of petroleum products constitutes about 4 percent of total U. S. petroleum consumption and is anticipated to grow in the future at a relatively limited rate.

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[6] The one-third of the undiscovered recoverable petroleum resources estimated to lie on the outer continental shelf cannot receive exploratory drilling until the submerged lands are leased by the federal government. It is now the policy of the Secretary of the Interior to accelerate the leasing of these submerged lands to 10 million acres per year for the next five years.

[7] The "Project Independence Blueprint" exercise of F.E.A. has a cast of thousands from the best available talent, but its petroleum projections depend on uncertain and unexplored resources being actually discovered in the future.

Growth in the domestic supply of petroleum is expected to be limited for up to 10 years because of uncertainty about resources and costs and long lead times for development. Given the 36 percent existing deficit in domestic supply and the expected slow rate of development of petroleum resources, it is expected that imported petroleum will be important in the satisfaction of U. S. demand for a great many years to come.

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Energy Research Opportunities for Agricultural Economists*

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THE HEAVY HYDROCARBON DEPENDENCY of intensified, high-yield, mechanized agriculture has been well publicized [3, 5, 6, 7, 10]. We estimate that fuel use in U. S. food production is at the annual rate of 1,050 trillion BTU's per year. That is equivalent to 8.742 billion gallons of diesel fuel. When energy use in processing, storing, transporting, and preparing this food is added, it amounts to the equivalent of 69.936 billion gallons of diesel fuel. In 1973 Hirst estimated that energy use throughout the food chain (production to consumption) accounts for nearly 12 percent of total energy consumption in the United States [5]. Hirst, Pimentel, and Whittlesey have shown that food production alone accounts for a relatively small portion of the total energy used in supplying food to the consumer [5, 7, 11]. The energy used to supply a year's worth of food to one person is in the area of 40 million BTU's or about 8 BTU of energy used per BTU of food energy consumed. Moreover the energy intensity of our agriculture has been increasing for several decades, and currently there are few prospects for reversing the trend.

This intensive, hydrocarbon-powered food system is a long, long way from the simple man, mule, and manure powered, self-sufficient agriculture of our own frontier days. Our agriculture is also worlds apart from those remaining primitive systems that rely mostly on solar-powered photosynthesis for their energy input. In the past we routinely and confidently encouraged such countries to follow our advanced technology. Lately we have begun to wonder about the desirability of doing so. Pointing with pride to our high ratio of "persons-supplied-by-one-farmer" has been replaced by viewing-with-alarm our very high ratio of "calories of energy used to produce one calorie of food."

We did not get where we are by accident, and it did not happen overnight. Our reliance on stored energy to fuel our agriculture has been growing steadily since the beginning of this century. Machine powered production, fertilizer, chemicals, specialization, transportation, and increased processing all have required substantial increases in the use of energy. All these changes were made for the best of economic reasons—to substitute cheap inexpensive factors of production (energy, technology, and machines) for the expensive factors (labor and land). Then came the 1973–74 energy crisis and suddenly everyone is aware of energy, afraid that we may have taken the wrong route, and wondering what to do next. Fortunately (we hope) agricultural economists have heard their entry cue and are rushing to help. It is our purpose in this paper to discuss some of the major problem areas created by the energy crisis as they may become researchable topics for agricultural economists. Carter and Youde briefly touched on this topic in their paper [1].

Current Activity

Just one year ago, agricultural economists devoting any significant portion of their time to energy questions were few and far between. The program for last summer's meetings in Edmonton reveals no invited papers and only three contributed papers whose title shows some focus on energy. Up to that time oil markets had behaved well and energy was just one small input providing an insignificant fraction of farm and industry costs. It seemed reasonable to take cheap energy for granted. Now the abruptly and completely changed picture is bringing about a significant reallocation of the profession's resources to investigate energy questions.

To determine how significant this shift has been, we sent a brief questionnaire to each department of agricultural economics in the U. S. and Canada in June 1974. Nearly 100 percent of the questionnaires were returned. The results shown in Table 1 indicate a decided upward trend in attention given to energy questions. Thirty departments had some energy research ongoing in fiscal year 1973–74. An average of

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0.70 scientist-man-years were devoted to energy research last year in those departments. A total of 25 SMY's was devoted to energy within the profession including the Economic Research Service. There are approximately 1300 professional agricultural economists working in university departments of agricultural economics and in the Economic Research Service, though not more than about one-half of this total is actively engaged in research.

An additional 10 departments plan to begin energy research activities in fiscal year 1974–75, and the entire 40 departments that would then be involved plan to devote 37.5 SMY's to energy research. In addition ERS plans 6.5 SMY's in energy research. The total is nearly double the 1973–74 level of effort. The average will be up to .94 SMY's per involved department if plans are realized. Virtually all of these departments expect their level of effort in energy research to increase still further after 1975. Twenty-three departments had no energy research in 1973–74 and plan none for fiscal year 1974–75.

Outside of our profession, the growth in economic research on energy questions has probably been more rapid. Our brother economists in general economic departments are becoming involved. The Federal Energy Administration is staffing a large economic research group. The Department of Interior and the Environmental Protection Agency have energy economics investigations. Outside of government, the foundations, the think tanks, and the consultants are devoting substantial and increasing amounts of resources to energy related economic research. Some agricultural economists are involved in these programs and some of the research is aimed at agricultural use of energy. But we did not extend our survey to these units, so we have no numbers comparable to those reported for the agricultural economics departments and USDA.

Table 1. Energy research in agricultural economics departments

	Ongoing FY 1973–74	Future FY 1974–75
Number of departments with some research	30	40
Average SMY/department with research	.70	.94
Range SMY/department with research	0.1–2.2	0.1–4.0
Allocation of Research (5)		
Agricultural use & impact	45	47
Supply, demand, & policy	31	27
Land use & environment	21	21
Other	3	5
Financial support (%)		
Appropriated funds	65	58
Contracts & grants	35	42

Approximately one-half of the energy research in agricultural economics departments is devoted to agricultural use of energy. General energy supply, demand, and policy problems receive about 30 percent of the total. Land use and environmental problems related to energy supply or utilization receive the remaining 20 percent. ERS differed significantly from the university departments in that more than 70 percent of its research effort was devoted to energy costs, economic growth, and foreign demand. Only 25 percent was devoted to agricultural use and impacts on agriculture.

About one-third of the universities' energy research was supported by grant and contract funds with that fraction rising to 42 percent in 1974–75. They were generally optimistic about the prospects for funds to support expanded energy research efforts.

The rapid buildup of research activity in the energy field requires that we consider the directions this research might take. We did not ask the specific topics of our colleagues' energy research, nor did we ask what methodology they were using or planning to use. Not knowing leaves us free to expound on our views of what to investigate and, to a lesser degree, how to conduct the investigation.

Areas for Research

Development of basic data

One of the most needy areas for early research is basic data collection. Agricultural economists venturing into the field of energy research will soon encounter a frustrating lack of basic data suitable for economic analysis. This lack is to be expected. There has been little economic research in energy topics to create a demand for data and guide the collection along lines that are suitable for economic analyses. The situation is similar to that which existed for other products and inputs many years ago.

There are some basic statistics on energy production and sales. However, statistics on energy use by particular categories of users, industries, or enterprises are very skimpy. These are exactly the data most needed for basic accounting of energy consumption. They are the missing link to valid estimates of energy demand functions for specific uses.

At the present time some of the best (or only) energy use data come from engineering estimates. Frequently there are no firm or industry records that conveniently yield the desired data. A few forays into collecting these primary data soon reveal wide variations from firm to firm not unlike the variations commonly encountered in investigations of agriculture and food industry operations. There is a great need for more survey and census data on energy use that will link analyses to actual operations rather than engineered estimates.

The rapidity of changes in the energy situation means that analyses need to press into untried areas. Enterprise and industry studies will need information from new technologies as well as from currently dominant technologies. Further, these data will have to be technologically labeled and time dated.

The collection of appropriate energy economic data will not be a simple or trivial task. The use of energy is pervasive throughout food and fiber production, processing, and marketing. There do not appear to be many neatly separable relationships. Interdisciplinary and coordinated efforts will be required in many cases.

Short run responses and adjustments

As energy demands press harder on energy supplies, there will be new and intensified efforts to cope with the problems created. Energy prices will rise as a natural response to market disequilibria, and producers and consumers will respond to the price changes. Price regulating schemes, taxes, and subsidy programs will be instituted or at least considered as means of restricting energy demands or increasing energy supplies. Each of these will require assessment for impacts on food and fiber demands and supplies. Adjustments in response to energy price changes need to be anticipated, wherever possible, in order to facilitate the changes and, in some cases, to avoid severe economic hardship on geographical regions, commodities, producers, processors, and consumers. Without concomitant and forward-looking research, it is possible that food production or distribution will be inadvertently disrupted.

A major short-run adjustment phenomenon will be "resource substitution." Even within the employment of present technologies there are many opportunities for adjusting factor ratios in response to the changing factor price ratios. As the real price for energy increases, labor, capital, land, water, and other factors will be substituted for energy. Though in most cases these substitutions will be gradual, the demand shifts for non-energy factors will have decided effects on their employment level and value. These factor employment shifts should be assessed and projected to smooth the adjustment process. In many ways this research will take on the character of the farm adjustment studies of the 1950s and 1960s. However, the impurity imposed by the energy embodiment in practically all factors of production adds a degree of complexity not encountered previously. Also, the dynamic effects of energy cost changes will add further problems. For example, present food costs reflect little of recent energy price increases.

A subcategory of resource substitution research would be an evaluation of the potential, extent, and impact of substitution among energy forms. The relative scarcity of individual types of energy will cause divergent energy price ratios to develop. Within the limits of presently employed technologies there will be immediate shifts from one energy form to another. The more apparent effects of these shifts will be seen in changes from one mode of transportation to another or from one method of food processing to another. Other adjustments will arise as those commodities heavily dependent on the scarcer energy forms are replaced by other commodities. Such impacts can occur throughout the production-processing-marketing-preparation food chain.

There also will be important product substitutions. Those commodities that are relatively more dependent on fossil energy inputs will be replaced by other commodities within the limits of production alternatives and consumer demand. Commodities with inelastic consumer demand will be forced to higher price levels imposing income effects on the dependent consumer. Commodities with elastic demands will experience reduced sales that may affect the income or well-being of producers. If these responses can be anticipated, it may be possible to ease the adjustment process and preselect desirable state and national policies for energy production, pricing, or allocation.

Other important adjustments will result from interregional competition and regional location effects. In general, production location in this nation has been established with little regard for proximity to consumer demand. A cheap, often subsidized, regulated transportation system using inexpensive energy has made it feasible to create a pattern of production with small concern for transportation differentials [2].

A very large proportion of the energy resources of this nation are used for transportation. Included in that calculation is the energy used to fuel cars, trucks, trains, and other public carriers, and also the energy absorbed in constructing the energy intensive transportation equipment and that used to transport oil, gas, and electricity to the user. Even a portion of the energy consumed in the process of converting fossil fuels into electricity is chargeable to transportation as it is converting energy into a more transportable form. At any rate, energy and transportation are very closely linked in our economic and daily lives. Scarcity of energy and/or higher prices will affect transportation costs and, in fact, the feasibility of continuing our present production, living, and transportation pattern. One consequence is that areas relatively remote from markets or input supplies will lose in competitive position relative to others. Agricultural economists have some useful skills for analyzing these sorts of shifts whether they apply particularly to shifts in agricultural specialization (which may be rather substantial) or to other industries.

In addition to effects upon location of production, rising transportation costs due to energy scarcity may in time have some important effects upon patterns of land use for nonagricultural purposes. Economists who are interested in land use and land use planning issues might well address their attention to these topics. Increasing energy costs may cause homes to be located closer to jobs or to mass-transit services which could affect the pattern of urban growth. Furthermore, changing costs of transportation may have a significant effect upon the locations chosen by people for recreation activities. Stay-at-home or close to home recreation activities may take some of the pressure off of rural recreation and also, by the way, some of the economic infusion enjoyed by rural areas that have recreational opportunities for urban residents. Alternatively, it may force some people to move permanently into rural or remote areas causing yet another kind of problem.

A variation of the regional location problem may come to the fore in the West where certain regions have built an economic base dependent upon irrigation, particularly sprinkler irrigation. Sprinkler irrigation has largely been developed on the basis of extremely cheap electricity, as low as one-tenth the cost of electricity to domestic consumers in the East. The costs of electricity for sprinkler irrigation are likely to rise markedly as the national power grid is expanded, new pricing schemes are implemented to reduce electricity demands or account for new sources of electricity, and pressure builds against agriculture's favored status in electricity pricing. It will mean an increase in production costs that, unless otherwise offset, will adversely affect certain geographical regions of the West.

The short-run adjustment problems mentioned here, while not exhaustive, serve to illustrate the class of problems immediately confronting the agricultural economist. Our economic theory, equilibrium models, optimizing tools, and simulation techniques, if properly applied, can make substantial inroads on these problems.

Technological assessment

In the short run, adjustments will fall largely within familiar present technologies, but in the long run, solutions to our impending food and energy problems may require substantial shifts in technologies, investment, life styles, diets, and concepts of population and economic growth rates. Evaluation of these long-run adjustment possibilities will provide some interesting and challenging opportunities for the agricultural economist.

Agricultural economists have some experience in technological forecasting and assessment. Analytical techniques and research strategies that have arisen in the development and adoption of new seeds or new cultivation techniques will have some applicability in the race to find technologies that will lessen the impact of the energy "crisis." Past experience encourages us to believe that many now unrealized opportunities to reduce energy consumption will emerge rather quickly in response to the incentive of higher energy prices. Experience also indicates a prime call for agricultural economists to work with other disciplines in bringing forth economically relevant technologies that have the stamp of *ex ante* economic assessment.

Large efforts and budgets must be devoted to developing new energy-efficient technologies for the future. Efficient use of research efforts in this development process is imperative. Economists will hopefully be called upon to provide some early screening of prospective developments so those with no hope of adoption may be phased out early. In addition we believe economists can help greatly with evaluation and coordination of the many and varied research efforts of industry and government seeking solutions in this general problem area. Frontiers of knowledge will be moving rapidly in some cases and very slowly in others. Payoffs may not be proportional to time or money investments for developing new technologies. Some developments may be incompatible with others, inoperative without others, or obsolete before adoption. The role of the agricultural economist in this fast moving maze of events would be to provide an assessment of future development to help with the allocation of research effort and funds of others. Shumway [9] and Searl and Perry [8] provide some guidance for the research allocation problems in their recent articles. In essence agricultural economists would be trying to improve the state of knowledge among researchers to increase the efficiency of the research process.

Research in technology assessment may occupy only a small share of the agricultural economists' time. A rather select group with abilities for working with mathematical models, other disciplines, and little data may be drawn into technology assessment as a major employment. Many others will be called in as "the economist" (token or not) on someone else's engineering or physics study. Especially in the latter case, good effort may go unrewarded, but it is nevertheless an endeavor where economists' input may yield large net social savings.

Energy and ecology

A major problem facing the future of this nation and the world relates to the close relationship between energy production and use and the quality of the environment. It is only necessary to list some of the major environmental problems facing the nation to realize the close links between energy use and environmental problems.

1. The air pollution problems that plague many cities and some whole regions result largely from the burning of fossil fuels in automobiles, homes, powerplants, and factories.
2. Water quality problems in some regions are traceable directly to drainage from mining operations, and in other areas waste heat from power generation of industrial processes is being discharged into water sources and causing significant degradations in quality.
3. Land damage, especially from strip mining has been an important consequence of energy resource exploitation.
4. Estuarian and salt water environments have been damaged and threatened by oil escaping from the extraction or transmission functions.
5. Electricity transmission facilities have been criticized for their adverse visual effects.
6. Nuclear power plants have been charged with introducing serious hazards from accidents or from insufficient control of waste materials.
7. The utilization of materials that are direct products of energy such as fertilizers, petrochemicals, or synthetics pose their own environmental hazards.
8. The consumption patterns that are associated with energy intensive transportation, such as highway networks and airports, have distinct environmental impacts.

Ironically, the environment is affected by both energy supply and consumption. A reduction in level of energy use would generally reduce the level of adverse environmental effects. So, there is a trade-off But it is also true that the relationship between energy use and environmental effects differs among forms of energy, methods of use, and locations of use. It makes a difference where and how the cuts are made. We were just entering a period of unprecedented environmental protection by the process of substituting "clean" fuels and "clean" processes for those that have larger environmental impacts. But that effort was aimed purely at substitution, while maintaining the rate of growth in total energy consumption. When the supply of "clean" energy was suddenly reduced, a hue and cry went up to resume use of fuels and processes with high environmental costs. The trade-off between energy and the environment is suddenly on different terms. People who advocated switching to save the environment are not so sure about curtailments when simple acceptance of more impurities in the air would permit us to use more energy.

Agricultural economists have some experience with market vs. non-market trade-offs. That experience should help us to develop more enlightened choices between energy and the environment, where the two compete. The basis for such choices is admittedly not as clean as microeconomic theory of the firm. But it is clear that such choices can be improved by quantification of the trade-off relationship in an opportunity cost mold. Work in water resources planning and evaluation suggests some appropriate methodologies. It may be possible, in some cases, to attach pseudo prices to some of the environmental consequences. There has been some effort along these lines for energy consequences although agricultural economists have not been heavily involved. More often than not, however, realistic pseudo prices will be unobtainable and multi-objective evaluation of some kind will be required.

Resource conservation

Another area of needed work that has emerged from the "new look" in energy is the old question of conservation vs. depletion of stock energy resources. There has been a growing realization that almost all of our conventional energy supplies are stock resources that sooner or later will be gone if use rates continue. The common understanding of this fact has grown tremendously in recent months. But, as far as we know, there is still no common agreement among economists as to what should be done about it.

For the past 30 years or so the predominant view among economists has been that technological change plus various adjustments and substitutions would take care of any scarcity problems. However, all along some people argued that dependence upon future technology is somewhat dangerous, and the threat of depleting stock resources should be included in decisions about rates of resource use over time. The market system does not give much attention to the depletability of stock resources. Now, with the growing chorus of voices concerned about energy scarcity, would be a good time to return to the topic of optimal resource use over time. Working out better estimates of discount rates, rates of use, and expected technological change will be of some help. But there is at least an equal need for economists to return to some very careful reconsideration of the fundamental theory regarding optimal allocation over time. A better resolution of that question would help greatly in deciding appropriate energy policy, and also, by the way, policy with regard to some other important depletable resources.

Pricing policies

The current high level of public concern about energy supplies springs from the feeling of essentialness that stimulates public concern about food supplies. As with food, so also with energy, there is a strong reluctance to leave the pricing of so vital a commodity to the untrammeled working of the market system. Perhaps some of the experience of agricultural economists with public interventions into food markets may provide insights that will help to avoid some serious problems with energy pricing policies.

Features common to both food and energy pricing include: (1) an effort to keep consumer prices as low as possible, (2) a tendency to consider demand an absolute quantity as though relative prices would have no effect on consumer choices, (3) an inclination to determine a "fair" price by calculating what would give a reasonable return to producers, and (4) a habit of giving producers tax incentives in order to give them "fair" returns, lower costs, and stimulate expanded production. We know from experience that such policies have, in the case of agriculture, led to problems of oversupply of product and excess commitment of resources with resulting low marginal value product. It is possible that current energy policies may backfire and leave us, five years from now, with an energy glut [4] and an excess of capital sunk in energy supply systems. Do "low as possible prices" really do consumers a favor and lead to the maximum societal welfare? These questions need to be answered, and agricultural economists should know some of the places to look for ultimate effects of well-meaning pricing policies.

There are of course some very distinct differences between energy and food pricing policies. One important difference is the degree to which monopoly generally and natural monopolies in particular arise in the energy field. But, despite these differences, the agricultural economist with the experience of 40 years of devotion to agricultural prices and policy may provide some useful inputs in dealing with emerging energy pricing issues.

Income distribution

Whenever a substantial economic change takes place in costs, prices, and quantities, there will be an important redistribution of income and economic well-being. In the case of energy, the redistribution will involve economic concepts that are quite familiar to agricultural economists.

One emerging distributional question involves the venerated economic bugaboo of economic rents. As Ricardo pointed out 150 years ago, certain surpluses now known as economic rents accrue whenever relative scarcity increases in a free market. Recent events in the field of energy clearly indicates that for various reasons we are pushing into a zone of significantly higher marginal costs of supplying energy. The higher marginal costs create a situation in which market prices rise unless explicitly controlled. If controlled, other problems arise. In the case of oil, natural gas, and coal, the controls are at the present time quite weak, and so prices are trending upward towards their marginal costs. Those producers who own rights to resources that can be placed on the market at far below the marginal cost are in a position to garner substantial economic surpluses. Nowhere is this more evident than in the case of oil where middle-eastern producers are profiting from the difference between their costs of a few cents per barrel and the world price of $7–$10 per barrel.

Closer to home, many of our domestic oil fields are able to deliver oil to collecting points at under $2 per barrel. It is only in the marginal cases where supply expansions are being attempted through tertiary recovery and development of remote fields in hostile, high cost environments that costs are near the current world prices. The economic surpluses that arise are somewhat similar to the rents captured by landlords in the market for the services of agricultural and other lands. More generally, they are in the general class of producer surpluses. In earlier eras, rents absorbed much professional and considerable public attention, but eventually interest waned. It may be a good time to dust off some of that earlier work and consider whether rent concepts can help us to understand and deal with drastically changing energy market situations. In the process, the ticklish question of equitableness of distribution of these surpluses will have been addressed. Also, there is a need to face the tensions between the efficiency gains from marginal cost pricing of energy and the equity advantages of forced pricing at a zero surplus (average cost) level. Eventually depletion of the low cost/high rent reserves will cause this distributional question to become less important. But, meanwhile, the distribution of hundreds of millions of dollars of income is at issue.

Conclusion

In this paper we have held to some basic premises. Hydrocarbon energy will become increasingly scarce and, hence, relatively more expensive in the years ahead. U. S. agriculture will continue to be heavily dependent on hydrocarbon energy inputs. This changing resource structure will pose many interesting and important questions inviting the research efforts of agricultural economists.

A general answer to what we should investigate and how we proceed seems obvious, at least to us. As agricultural economists enter the energy field, they should play to their strengths. In general these are in applied economic research, interdisciplinary research endeavors, agricultural and natural resource topics, and rural region and community affairs. We have considerable experience in these areas and a good deal of success to show for our efforts. The changing energy situation opens up a number of opportunities for us to apply our acquired skills to important economic and social problems that are or will be arising as a result of the changing energy situation.

While we have made no effort to rank the problems involving energy among the many other problems occupying agricultural economists, energy looms as a growing problem area in the future. Certainly the public and the policy makers need and deserve better information than is presently available in this field. Efforts devoted to well conceived and conducted research in this area should provide high returns, both socially and professionally.

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Session 1

ENERGY AND U. S. AGRICULTURE

Discussants: Loyd K. Fischer, University of Nebraska; Linley E. Juers, Economic Research Service, Colorado State University; Timothy D. Mount, Cornell University

THE ROLE OF COOPERATIVES IN FUTURE AGRICULTURE

Chairman: Marshall R. Godwin, FCS, USDA, Washington, D. C.

Cooperative Strategies in Imperfectly Competitive Market Structures—A Policy Perspective

Ronald D. Knutson

Agriculture is frequently cited as operating in a sea of atomistic competition. A basic premise of this discussion is that such an analogy is rapidly becoming obsolete. Cooperatives are adjusting to this imperfect competition by developing their own growth strategies. Horizontally, vertically, and conglomerately integrated cooperatives are being formed to compete effectively with comparably organized corporate entities.

Economists including those in the Farmer Cooperative Service and the universities play an influential role in advising cooperatives on growth and marketing strategies including the development of ". . . blueprints for cooperatives. Such blueprints have from time to time included concepts such as a single cooperative handling a major share of a product; mergers between cooperatives; advising on the desirability of closed membership, treatment of the nonmember, or the need for full supply contracts and marketing agreements."[1] Some have become involved in developing a rationale for cooperative involvement with corporations in various joint venture configurations [8]. The Capper-Volstead Act allows "persons engaged in the production of agricultural products as farmers" to act together in associations in marketing their commodities. The antitrust exemption conferred by the Capper-Volstead Act is not absolute. Certain activities of cooperatives such as the involvement of nonfarmers can destroy the exemption. Other activities such as predatory practices go beyond the shelter the Capper-Volstead Act provides.

During the past two years six significant new antitrust suits have been filed against cooperatives either by the Department of Justice or Federal Trade Commission. Three of these suits allege various predatory and monopolistic practices by cooperatives in the milk industry. Two involve corporate integrator involvement in cooperatives which make price and production recommendations to their members. One involves a joint venture between a cooperative and a noncooperative. During this same period the Department of Agriculture took action to curb custom feeding in livestock. This action was sufficiently broad in scope that it will likely also limit cooperatives developing integrated production-marketing systems in livestock. Finally, in June 1973 the assistant attorney general of the Antitrust Division, Department of Justice, called on Congress "to reevaluate the need for and scope of this [Capper-Volstead] immunity" [10].

Some very important issues of social consequence are raised by the Kauper testimony as well as the related antitrust suits. They raise the central question of the degree and methods by which cooperatives will be allowed to respond to structural change in the production and marketing of agricultural products.

Accordingly, this would appear to be an ideal time for evaluation of the changing structure of agriculture, its implications for cooperatives, and some analysis and suggested solutions to critical policy issues existing in the cooperative sector.

This reevaluation is done in the spirit that the appropriate time for public interest evaluation of structural change is while the foundation for change is being laid. I do not mean to imply that it is my belief that major problems of monopoly exist within the cooperative sector. Quite the opposite is the case. In fact the bulk of cooperatives operate in an inferior market position. However, without such evaluation more restrictive decisions may be imposed upon the cooperative sector in the future either by court or legislative action. The extreme consequence is the

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[1] For an illustration involving a blueprint for a purely cooperative agricultural marketing system, see [11].

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danger of losing the Capper-Volstead Act itself as the basis for continuing cooperative marketing activity.

The effect of such action could be to restrict cooperative growth and/or market activities to an extent which makes it impossible for cooperatives to compete in today's industrialized agricultural environment. On the other hand, cooperative monopoly will not likely be tolerated. A realistic balance must be struck between producers' need for an effective voice in the market and the public interest in maintaining workable competition.

My paper is divided into four parts. (1) It will verify that agriculture is characterized by imperfect competition and that it is becoming increasingly imperfect. (2) It will argue that the impact of this imperfect competition is increasingly extending to the farm level. (3) It will show that cooperatives are finding themselves caught up in a competitive framework which pushes them in the direction of more centralized and coordinated systems. (4) It will set forth ideas for the development of workably competitive cooperative structures and strategies. These suggestions are made with the realization that cooperatives must not be constrained to the extent that they cannot effectively adjust and therefore compete in a changing agricultural environment. It is also done with the realization that if the public gives a certain organizational form rights and privileges not granted other organizational forms, it might reasonably expect a higher level of accountability for performance in the public interest.

Agriculture's Imperfectly Competitive Structure

The pervasiveness of imperfect competition in agriculture is not generally recognized. If it is recognized, it is seldom taken into consideration. More often than not our research is done in a vacuum of purely competitive explicit or implicit assumptions, this despite the extensive verification provided by the National Commission on Food Marketing a full decade ago.

Statistics on the extent of imperfect competition are always found wanting. Latest statistics on market concentration bring us to the year 1970. Using the Bain classification, unconcentrated industries account for less than 30 percent of the value added in food manufacturing. Fifty-five percent of the value added is in industries where the eight largest firms have over 70 percent of the market or the four largest firms have over 50 percent [13, p. 6]. "Nearly 30 percent of all food industries value added falls in the definition of highly concentrated or very highly concentrated oligopoly" [13, p. 3].

High concentration is not limited to any single market level. It begins in the final product markets with high levels of retailer concentration. In 1970 the 20 largest food chains accounted for 40 percent of grocery store sales. This was an increase from 30 percent in 1954. From 1954 to 1967 SMSA tabulations indicated that the market shares of the four largest chains increased from 45.5 percent to 51.1 percent [13, p. 8].

Down the market channel from the retail level one can cite many illustrations of highly concentrated oligopoly. The pervasiveness of high concentration and monopolistic practices in the grain and cereal industry is illustrative. The macaroni and bread industries have been prime targets for price fixing conspiratorial activities [3]. Best indications are that the five largest grain companies export roughly 85 percent of food and feed grains from the United States. The power of these firms in terms of U. S. producers is importantly enhanced by their pervasiveness in the grain markets of other major grain producing countries. The four largest cereal manufacturers control 90 percent of cereal production [16].

While the meat industry is frequently cited as an industry where concentration is declining, a closer look indicates imperfect competition pervades the industry—particularly in local markets and therefore in the control of price making institutions at the producer level. A Packers and Stockyards study indicates, for example, that most of the major lamb markets are dominated by one or two packers [2]. Out of 40 states studied, P&S found that only 12 states had steer and heifer packing plant four firm concentration ratios of less than 65 percent. Only four out of 40 states had plant concentrations of less than 65 percent for hogs and none for sheep and lambs [2]. Central livestock markets which serve as the pricing base for the hog industry today handle less than 16 percent of the hogs. More often than not they are dominated by only a handful of buyers. Cattle prices are based on what is generally recognized to be a highly imperfect yellow sheet market. Broiler integrator numbers have declined to the point where roughly the largest 10 firms control one-third of the production and the largest 20 control 50 percent.

Impacts Extending to the Farm Level

At one time agricultural economists and antitrust regulators might have justified themselves ignoring imperfectly competitive structures in food manufacturing and retailing by noting the more highly competitive nature of central commodity markets. This rationalization was, in my opinion, suspect long ago. It is suspect today when price changes at the farm level are translated through to the retail level only after considerable time and frequent jawboning, if ever.

Yet, tentacles of market power are extending more directly to the farm level than just the monopolistic effects of administered markets. Increasingly, they are directing production at the farm level—not through ownership, at this point in time, but through contracts. These contracts, while advantageous from the standpoint of coordination, substantially change the power position of the producer. His decision parameters are restricted. He is a less autonomous financial entity. He is rewarded for a different set of inputs. Frequently he is frozen into production and marketing arrangements with few alternatives. It is not unusual for the producer unknowingly to lose title to his product and possibly his status of a producer under the Capper-Volstead Act.[2] Growers of potatoes for processing, for example, recently discovered a provision in their contract with a large processor whereby title passed to the processor at the time when the potatoes were planted.

Under these conditions the integrator increasingly becomes the gatekeeper for the industry. As concentration increases, oligopsonistic credit, production, and ownership arrangements make producer transfer from one integrator to another more and more difficult.

The price and resource allocation effects of imperfect competition in food industries are difficult to judge. Adjudication of two price fixing cases in the bread industry lowered consumer prices in the relevant market about 15 percent [7].

The work we have done with teleauctions in the lamb and feeder pig industry would seem to indicate a 7 to 10 percent price suppressing effect resulting from restricted competition in the purchase of these livestock relative to the prices existing in a broader based tel-o-auction market with freer market access, improved grading, and market information [9, p. 5].

Developing a Workable Competitive Cooperative Structure—Some Ideas

The basic theses of this discussion have been that agriculture is characterized by imperfect competition and that trends indicate that it is becoming increasingly imperfect. Cooperatives operating in this environment find themselves caught up in this competitive situation. They find themselves compelled to grow in the same dimensions as their corporate counterparts. The alternative runs the risk of foreclosure from significant market outlets or production itself.

In the imperfectly competitive situation I have described, the question of what constitutes an optimal cooperative structure from the standpoint of producers as well as society in general is not easy to answer. At one time we might have been satisfied with any degree of concentration of cooperative power contending that the dangers of too much producer power are miniscule compared with the dangers of corporate concentration. With any cross-sectional look at agriculture one with an agricultural bias might still conclude likewise. Yet, questions are increasingly being asked concerning what are appropriate constraints—internally or externally imposed—on cooperative activity. I will confine my remarks to seven areas which touch on several critical policy issues.

Cooperative size

The question of how large cooperatives should be allowed to get is inherently a judgment question. I am sure all economists interested in cooperatives have been questioned as to how it is that we can advocate increased merger activity among cooperatives in light of the AMPI lawsuits. It is a common misconception that the AMPI suit involves the size issue per se. Size may have been one factor drawing attention of the Department of Justice to AMPI, but the suit itself is against alleged predatory practices—attempts to foreclose markets to nonmembers, drive nonmembers into the cooperative, and force proprietary processor or other cooperatives out of business. The remedies sought by Justice do not relate to size but to practices.

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[2] The question of whether the contractor or the grower is a producer under the Capper-Volstead Act is currently under litigation in *U. S. vs. National Broiler Marketing Association*. In the case the Justice Department argues that the contractor cannot be the producer because he does not bear "substantially all the risk associated with producing broilers." Such an argument would appear to be, at best, tenuous. Loss of producer status could directly affect the growers' right to form cooperatives.

The Capper-Volstead Act itself says nothing about size. It says farmers may act together in cooperative associations and that such associations may have agents in common. This general language has been interpreted to mean that cooperatives can combine even to the extent of controlling 100 percent of the market [5, 14]. But, is 100 percent control a wise strategy from the standpoint of protecting the long-term viability of cooperatives and the Capper-Volstead Act? As a general prescription it is not. Two questions need to be asked: What size is needed to perform the marketing functions effectively and efficiently? What size is needed to compete effectively or countervail the power of the proprietary sector? Applying such criteria involves a combination of empirical analysis and judgment. In the grain industry, for example, one could hardly justify on either basis a single U. S. cooperative handling all the grain. One could, on the other hand, probably justify a joint venture of all cooperatives effectively to penetrate export markets for grain. In a contract integrated situation such as broiler growers bargaining with integrators or potato growers bargaining with processors, it may take a large share of market coverage for growers effectively to countervail power in the proprietary sector.

What implications does this have for the direction of cooperative growth—horizontal, vertical, and conglomerate?

First, the objective of the horizontal growth strategy is to obtain as nearly complete control of production and marketing as is needed to procure and assemble farm production most efficiently. The broader the base of control, the greater the potential for both countervailing the monopsonistic or monopolistic pressures existing on the corporate side of the market. Accordingly, the greater the potential for exercising a degree of market power on behalf of the producer, the greater the potential for infringing on the consumer interest.

This horizontal consolidation approach was typically used by cooperatives in the milk industry. The basic problem encountered by cooperatives utilizing this strategy has been that once the base of control becomes too broad, the spector of charges of monopolistic cooperative activity rises to the surface. This happens in part because of the large size and market control associated with such strategies. It also happens because the cooperative may not properly constrain its activities in recognition of the added power that it has achieved. Thus, while any one of the milk cooperatives is not tremendously large when compared with their corporate counterparts, they may not have properly constrained their market activities in recognition of the fact that they had grown substantially in size. The predatory activities in which they are alleged to have engaged had the effect of magnifying their size in the eyes of the public manyfold.

Does it make any difference if growth is by federation, centralization, or joint venture? I believe that it does. Centralized control is the tightest form of cooperative organization. Some apparently feel that the solution to all cooperative problems is merger and the formation of a centralized cooperative. Merger does have advantages particularly in the higher degree of management control that is implicit. But all tasks do not require merger. Federating and joint ventures among cooperatives combined with supply and/or marketing agreements make sense where market coordination is a necessary end. The standby pool in the milk industry, buying and refining crude oil, manufacturing fertilizer, or penetrating export markets for grain are illustrative. The point is that in each of these areas a larger scale of cooperative activity is needed to operate efficiently and compete effectively with agribusiness counterparts. Consolidation is not, however, required at local and regional cooperative levels. This should not be taken to mean that federations can be formed on an ad hoc basis without restraint. Federations of cooperatives for monopolistic purposes will likely not be allowed in the cooperative sector any more than they are in the corporate sector.

A second alternative growth strategy is to integrate vertically into the market channel. Vertical integration has three advantages over horizontal growth. First, it has the potential for generating greater stability of returns to producers. Profits in food manufacturing and distribution generally run countercyclical of prices at the farm level. Second, vertical integration gives the cooperative increased control. Assurance of a market outlet is increased. Third, the antitrust regulatory agencies have not viewed vertical growth as creating the same *degree of danger* as horizontal concentration. This is the case even though the power dimensions of the vertically structured firm including the ability to foreclose markets, use leverage, discriminate in prices, control production, create barriers to entry, and segment markets are well recognized [1, 4].

The main disadvantages of vertical growth lie in its required capital intensity and management expertise. In any established product area a certain minimum or threshold appears to exist for effective vertical market penetration. Take the export market for grain as an example. Only five proprietary firms appear to be effective in the export market for grain. The smallest two of these firms each have about 10 percent of the market.

If cooperatives were going to make an effective vertical integration into exports, they would need to penetrate at least to a comparable share with these smaller exporters. This concept of a minimum share needed to be a significant market force has application to most market situations where large firms compete and in effect administer the market. The minimum share must be achieved before the cooperative can expect to generate the stable market advantages of forward integration. Substantial size and therefore substantial capital commitment are generally required to meet that minimum or threshold size.

The third channel for cooperative growth involves conglomeration into new market or product areas. In recent years this has been a main avenue for corporate growth. It appears to have a minimum antitrust risk. Whether cooperatives should attempt to emulate the corporation and take on additional product functions stands as a major question that needs to be answered. It is not an easy question to answer.

The ability of corporations to transfer funds from one product area to another could stand as a major obstacle to a continuing cooperative role in agriculture. Therefore, diversification in cooperatives may be as important in the survival of the cooperative as it has been to the survival of the family farm. Inherent questions in cooperative conglomeration would appear to be three-fold. First, does cooperative management have the capacity to control a large conglomerated cooperative? Second, can the degree of producer involvement required to retain the cooperative focus be maintained in a large conglomerated organization? Third, will producers be willing to commit capital needed to support large cooperative conglomerates?

What should be clear with respect to the size question is that the larger a cooperative gets, particularly in horizontal dimensions, the closer it will be watched in terms of the practices it engages in. In addition, the more developments it will get the blame for—increasing consumer prices, for example. Size should not become a virtue in end of itself, but the size needed to be efficient and competitive should be a primary guide for cooperative growth.

Over time I see more and more constraints being placed on cooperative growth. Such constraints extend to interactions among marketing cooperatives which have price enhancement implications. I expect antitrust agencies to look with increasing disfavor at pricing arrangements among cooperatives—particularly cooperatives with processing facilities.[3]

Nonmember problem

The question of the obligation of cooperatives to the nonmember rises to the surface in the AMPI litigation. The larger the cooperative gets the fewer market alternatives open to the nonmember. In fact, the more industrialized agriculture becomes the greater the squeeze on the nonmember farmer. The independent firm has always been an important element in our economic system. It has therefore continuously been the subject of extensive antitrust protectionist policies.

Good common sense and the bounds of the Capper-Volstead Act are clearly drawn when it comes to predatory practices designed to drive the nonmember into the cooperative. It seems quite clear that neither economic coercion nor noneconomic pressure tactics will be tolerated as a means of increasing cooperative market control. The cooperative is by nature a voluntary membership institution and will likely remain so.

The principle of voluntary cooperative membership can be difficult to retain under certain conditions. Such conditions exist in the milk industry. When cooperatives control a large proportion of the milk supply in a market, there may be no way for the producer to get his milk to a processor efficiently unless the cooperative is willing to haul it. Then can the cooperative demand that the independent producer become a member? Likely not. In other words large marketing cooperatives may have to give up their right not to serve the nonmember. Can the cooperative charge the producer for a portion of the overhead cost of operating the cooperative as well as a hauling cost? It should be able to.

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[3] Such disfavor could be expected to extend to currently acceptable marketing techniques such as central sales agencies for cooperatives which together control a substantial share of the market.

Clearly he can be charged for the direct costs associated with hauling. However, any higher charge may be viewed with skepticism by a regulatory agency as economic coercion.

One of the costs of becoming large may well be that the cooperative is going to have to bear a portion of the costs of marketing associated with the nonmembers. An alternative in the milk industry would be to set up an extensive rate making function to determine costs of providing services to the nonmember. Considering the lack of success of rate regulation in our economy, such would hardly be a desirable strategy. Another alternative would be placing the burden of proof on the cooperative to cost justify charges made to the nonmember for marketing services performed.

Bargaining activities

Capper-Volstead clearly gives producers the right to join together for the purpose of establishing price [10, p. 13]. Theoretically joint pricing activities among cooperatives are allowed as long as a common cooperative marketing agency exists as an umbrella for such activities.

Until recently joint pricing activities of cooperatives have consisted largely of bargaining over terms of trade in contract-integrated situations. The typical situation where the need is the greatest is in a case such as broilers, canning peaches, tomatoes, or potatoes for processing where a relatively high concentration of power exists on the buyer or processor side of the market. In such instances bargaining associations play the dual role of countervailing the monopsonistic power of the processor and negotiating a price for the product being produced. The value of the price-making function of a bargaining cooperative should not be underestimated in contract commodity situations.

The problem is that the Capper-Volstead Act was not designed for the bargaining situation.[4] It does not comprise the good faith requirement tools needed for effective bargaining in contract integrated agriculture. In addition, the danger exists that we place too much burden on a single law if we require that Capper-Volstead be the enabling base for both bargaining and operating activities. This in and of itself is a reason for seeking separate legislative base for bargaining—a base which would define a bargaining association and the conditions under which it would take place.

In this regard I am sympathetic to an idea that bargaining associations should be defined in a way to exclude processors from being required to bargain in good faith with cooperatives having operating (processing) functions. Such a provision would tend to temper the impressive power blocks that could potentially be developed in a cooperative having processing facilities of its own while supplying the products used by proprietary concerns. This is important when it is realized that one of the landmark cases in antitrust law, the Alcoa case, involved the use of market power created by the fact that Alcoa could by raising the price of aluminum ingot put its own processing facilities at a comparative advantage. I expect that over time joint pricing activities of operating cooperatives will become increasingly restricted either by court interpretation or new legislation.

Corporate involvement in cooperatives

Recently there have been a few isolated instances of integrated corporations forming cooperatives among themselves or with other cooperatives and independent producers for purposes of marketing products as well as influencing production and prices.

Suppose, for example, that the hog industry became highly integrated with 20 major corporations producing over 50 percent of the hogs. Should such producers have the right under the Capper-Volstead Act to own packing facilities jointly with independent producers and cooperative feeding operations? As a separate question, should they be allowed to form a cooperative which would allocate production and determine pork prices? This gets us directly into the question of cooperative-corporate joint ventures.

For purposes of this discussion, joint venture exists when two or more firms each have ownership (equity) interest in a third firm. Such an arrangement implies a sharing of decisionmaking, risk, and profits or losses. A joint venture is, therefore, more than a supply arrangement. Joint ventures may be among cooperatives, between cooperatives and corporations, or among corporations. A body of antitrust law has been developed in joint ventures among corporations which apply standards including the need for venture, extent of market foreclosed, and the extent to which the parties could have entered the jointly owned function independently.

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[4] In saying this I do not mean to imply that bargaining is not comprised in the overall marketing concept of the Capper-Volstead Act. Bargaining is an integral part of the pricing function which by economic standards is marketing. For a good recent legal opinion on this point see [15].

Joint ventures among marketing cooperatives enjoy the protection of the Capper-Volstead Act inasmuch as they constitute a marketing agent in common. Functions requiring larger scale operations than that of any one firm and/or close coordination of production, processing, and marketing are particularly adaptable to a joint venture. The benefits of such ventures are channeled back to the producers.

Superficially joint ventures between cooperatives and corporations have the same intuitive appeal. Closer analysis indicates two primary risks. First, there are antitrust risks inherent in cooperative-corporate combinations. This fact involves one of the most basic and prevalent lessons of antitrust litigation with regard to cooperatives. At least two Supreme Court cases have ruled marketing cooperatives outside the protection of the Capper-Volstead Act when cooperatives combined with corporations [17, 12]. A third decision has ruled that cooperatives cannot involve nonproducer interests in their membership structure [5]. One of the first major joint ventures in marketing between a corporation and a cooperative—the Heublein-United Vinters venture—is currently being challenged by the Federal Trade Commission.

Second, more often than not joint ventures between cooperatives and corporations evidence substantial disparity in size of firm, the cooperative being much smaller than the corporate entity. Such a disparity runs the risk of producer interests being secondary to those of corporations.

For most instances it is my belief that supply arrangements stand as a suitable substitute for joint ventures between cooperatives and corporations. Where substantial economic justification exists and nonmember producers are not foreclosed from a market, the legal status of such arrangements is much less questionable. Where foreclosure is a problem, a frequently used legal compromise exists in some proportion of the supply being assured to a processor leaving the remainder to nonmember producers.

The second case, that of corporations joining with each other or with cooperatives and independent farmers as members of a new cooperative for the purpose of influencing production and/or prices, presents a different but related problem. In certain respects it is more closely related to the bargaining situation where producers are powerful and cohesive enough to dictate prices. Without Capper-Volstead, such activity is price fixing and therefore a *per se* violation of the Sherman Act. Corporate-cooperative combinations for purposes of influencing prices or production have sprung up in commodities such as broilers and lettuce where (1) production is subject to sharp cyclical fluctuations, and (2) the participants in the bargaining effort are involved in production either by highly specific production contracts as in broilers or by direct ownership of landed resources as in lettuce.

Integration by agribusiness firms into production has written agribusiness firms into the producer class. The greatest danger from corporate involvement in cooperatives is that once corporate agribusiness comes under the Capper-Volstead Act, it may be only a matter of time until the Act itself is either repealed or so severely restricted that its usefulness to family farmers is drastically limited.

To protect against this consequence, the following remedial alternatives exist. (1) Cooperatives could voluntarily purge their organizations of corporate agribusiness producers or limit the degree of participation by any particular member. (2) The FTC and Justice Department could carefully evaluate the legislative history of the Capper-Volstead Act raising the question in its litigation whether the intent of Congress was to provide antitrust protection for corporate activity in cooperatives. It is my feeling on reviewing the Congressional Record that a strong case can be built against corporate involvement in cooperatives, particularly when one considers the substance of what was sought to be accomplished by the Capper-Volstead Act. (3) The Act could be amended to exclude corporate agribusiness components. Whenever legislation is opened for amendment, it runs the risk of being overamended or repealed entirely. (4) The Secretary of Agriculture could under the undue price enhancement provisions of Section 2 of the Capper-Volstead Act take a more active role in regulating cooperative activity. Such an active role could extend to more concise definition of what constitutes a Capper-Volstead cooperative and close scrutiny of the behavioral and pricing activities of cooperatives. This approach says that we should judge cooperatives by their performance rather than their structure. It has intuitive appeal. But it can put the Secretary of Agriculture in a position opposite to the interests of his main clientele—the farmer.

Production control

It is well established that if cooperatives are going to raise prices significantly, they must be in a position to control production. At the same time it is argued that control of markets by cooperatives, even to the extent of monopoly, is innocuous to the public interest as long as the cooperative does not control production. This is a principle to which I subscribe. However, opportunities for cooperative contribution to producer welfare are not eliminated by an absence of control over production. Some of the greatest benefits of cooperatives arise from greater stability of prices and returns, retaining decision making authority at the producer level, assuring producers of an outlet for their products and assurance of input supplies.

Antitrust litigation against the use of production control devices in the private sector is extensive. This litigation indicates efforts to control production fall in the same *per se* illegal category as price fixing [19]. One case has been litigated involving cooperative efforts to control production in lettuce. In that case the Government enjoined the cooperative from limiting production of lettuce and from destroying lettuce already grown. The case was dismissed when the production agreement expired [18].

It can readily be argued that the employment of production control devices places cooperatives in the same class as the corporation, therefore not warranting them special antitrust protection. If production control is a necessary aspect of effective cooperative marketing activity, it would appear that it should be undertaken under the guise of a marketing order of similar legislative protection.

Closed membership

One way of controlling production, at least within the cooperative, is to close membership. Membership may be closed for a number of reasons. Three would appear to be particularly important. (1) Limited capacity of operation makes acceptance of additional membership technically infeasible. Expansion of operation requires a large additional lump sum investment which is beyond the scope of the cooperative. (2) The cooperative desires to serve a specialized market where a high level of control of production practices is necessary effectively to penetrate and retain the desired market. The cooperative must be in a position to choose those producers who can meet production requirements. (3) The cooperative desires to use membership as a means of restricting the quantity of product flowing to market and therefore enhancing producer returns.

It is doubtful that cooperatives can retain the public trust while closing membership for the purpose of substantially enhancing producer returns. On the other hand, there would appear to be a strong argument for treating closed membership on a rule of reason basis under the antitrust laws. That is, cooperatives should be in a position to justify their membership policies as a necessary requirement for serving the relevant market. Corporations are able to pick and choose among producers in meeting their market requirements. Cooperatives should not be put at a disadvantage relative to the corporation in terms of being able to address their markets most effectively. On the other hand, a higher level of performance affecting the public interest might well be expected of the cooperative. Therefore, closed membership policies should be carefully evaluated both in terms of their implications for producers and their public interest aspects.

Marketing agreements

A cooperative marketing agreement legally binds the producer to market his produce through the cooperative for the period of the agreements. Cooperative agreements are similar to marketing contracts in the corporate sector. They are, in effect, cooperatives' means of contract integration.

Marketing agreements are commonplace in many areas of cooperative activity; milk, citrus, processed vegetables, cranberries, grapes, rice, cotton, and sugar beets are illustrations. Other sectors of cooperative endeavor are just beginning to consider the potential for marketing agreements. An example is grain.

As vertical coordination in the corporate sector increases in importance, cooperatives will increasingly be required to enter into similar arrangements which permit forward planning, production scheduling, and forward sales by the cooperative.

Marketing agreements encounter relatively few regulatory policy constraints. When they are entered into, however, they do foreclose these products from entering the open market and have as a result from time to time been criticized. They are currently a subject of challenge in the AMPI litigation. This challenge arises because of the extended duration of the agreement—three years. The history of antitrust regulation in the corporate sector suggests that supply arrangements, which are a type of marketing agreement, must be reasonable in length and consistent with a rational economic purpose which is required to meet market needs. In the early stages of a new cooperative marketing program an agreement of multiproduction period duration may be essential to getting a new program off the ground. On the other hand, once a program is on sound footing, shorter agreements may be possible—normally covering a year or a production period with a self-renewal clause. The important point here is that the hands of cooperatives should not be tied in developing coordinated systems. Nor should cooperatives take advantage of marketing agreements for the purpose of creating a closed system which is tantamount to compulsory marketing to serve exploitive ends.

Concluding Remarks

The effect of the position I have taken can be asserted to thwart the efforts of cooperatives and their agricultural economist advisers to develop an effective cooperative system. I do not believe that is the case. But it does affect the *kind of system* that is developed and the *philosophy* with which it is developed. Economists and cooperatives who think they can develop cooperatives with monopoly control under the guise of developing a market-oriented system should think twice. Developing a market-oriented system is not equivalent to developing a monopoly. Two guiding principles for cooperative growth fall out of this discussion:

1. Cooperatives should have as their goal equaling but not exceeding the market position of the firms they are supplying or competing against. In other words they should remain competitive, not monopolistic, and satisfice, not maximize.

2. Cooperatives should take steps to remain pure and family farmer-oriented in order to protect the Capper-Volstead institution from attack on the grounds that the cooperative is no different from any other business entity.

If these steps are taken, I foresee a healthy future for cooperatives held by the body politic as operating in the producer as well as the public interest.

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The Role of Low-Income Rural Cooperatives in Community Development

T. T. Williams

The role of Emerging Cooperatives in community development must be analyzed from two dimensions: civic sophistication of the leadership, and economic thrust of the activities and educated awareness of the membership. Casual observation of the extent to which these entities are being realized leaves much to be desired. The Emerging Cooperative Movement is in need of support in both areas in order to exert the maximum impact on community development [16]. The Emerging Cooperative Movement has proven to be an effective weapon in the poverty war arsenal. The movement has served as a motivator of community pride and as an instrument for the members' involvement in community development activities [16].

Emerging Cooperatives are usually referred to as a group having a high percent of low-income members. These are the cooperatives organized and managed by individuals who are the residuals of an affluent society. The members are predominately black, educationally disadvantaged, economically poor, and politically dispensable. However, the growing number of Emerging Cooperatives dramatizes the faith and confidence the members have in the movement [14].

It is estimated that there are some 2,500 Emerging Cooperatives with a combined membership in excess of two million. These numbers take on greater significance when it is recalled that less than 20 years ago there were less than 100 such cooperatives with a membership of about 10,000. In 1969 the Office of Economic Opportunity published for the first time a "Co-op Directory" listing some 200 low-income cooperatives organized as a result of the Economic Opportunity Act of 1964 [9].

Civic Sophistication

In the final analysis, the catalytic agent for community development is a determined group of people, knowledgeable about how the political machinery can be utilized to improve the quality of life [5]. Over the years, the Emerging Cooperative Movement has been that catalytic agent in many rural communities, but the political sophistication to sustain and accelerate the thrust is floundering for lack of aggressive support.

From a civic viewpoint, the Emerging Cooperative Movement has been "community oriented." The civic thrust of the movement reflects the composite of the members who are residents of the neighborhood, work in the community, and spend the major portion of their earnings for basic necessities. The members mirror the civic goals of individuals similarly situated in the rural or urban community [1].

While the ultimate civic goal of the Emerging Cooperative Movement has been to improve the quality of life for the membership, the immediate thrust has been playing catch-up. Usually, when community problems have been diagnosed, programs formulated, and regulations promulgated, the members of Emerging Cooperatives are brought into action to assist with the implementation. Seldom are the members consulted for input or advice during the development stage of the program. The result is that programs intended to encourage community involvement fail to reflect the needs of that section of society, earlier referred to as the residuals of affluency [14].

The greatest growth period for the Rural Emerging Cooperative Movement was during the 1960s. These were also the years in which society was experiencing many changes as more Americans were demanding a greater role in all affairs affecting their daily activities [9].

Members of the Emerging Cooperative Movement were attempting to utilize the cooperative principles at a most difficult time in history. This was a period in which we failed to share the cooperative experiences with an emerging group determined to share in the fruits of a highly developed society [10].

Experiences of the Emerging Cooperative Movement provided this country with a keener insight into the civic potential and the economic plight of the residuals of affluency in community development.

During the greatest growth period of the Emerging Cooperative Movement, this nation

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experienced significant changes in the characteristics of rural America [2]. Our stockpile of arsenal to fight the poverty war was at its greatest strength while the number of family farm operators and their families were moving to urban centers ill-prepared for the new life style [6]. On the surface we made inroads in the area of equal opportunity while sharp differences continued to exist between the economic status of black and white Americans residing in both the rural and urban sectors [17].

The 1972 median income among whites was $11,457 compared to $6,864 for blacks. Even though the proportion of black workers in the total work force jumped by 8 percent between 1966 and 1972, most blacks were employed on jobs paying low wages. Compared with the national average, the unemployment rate for blacks is four times greater than that for whites [12].

We know from experience that it is most difficult to mobilize communities when the purpose of getting people to work together is to challenge the conditions causing discrepancies in income and employment. Too often this has been the main civic thrust of the Emerging Cooperative Movement.

The Emerging Cooperative Movement is partially responsible for organizing the largest exercise in participatory democracy in rural America. Support for this observation is revealed by studying findings of the Joint Center for Political Survey [8]. The study findings reveal that the number of blacks holding elective offices increased over 150 percent from 1969 to 1973. The greatest gains were recorded in the rural areas of the South where the Emerging Cooperative Movement received popular support from the residuals of affluency. Leadership of Emerging Cooperatives capitalized on the growing concern for involvement to gain greater community support [3].

In many instances the early "community oriented" thrust of the movement was to challenge the insensitivity of the establishment. The establishment usually fought back with all the power at its command. In the process a communication void was created at a time when cooperation was so necessary for the development and the implementation of community development programs.

During the formative years of the Emerging Cooperative Movement, we also witnessed a decline in the caliber of grassroot leadership [13]. Rural communities were left with some difficult problems in that leaders with the proven ability had left the areas in search of a better life in the city [4]. The leaders who surfaced to guide the community and the Emerging Cooperative Movement experienced difficulties in motivating the people and gaining membership support.

Today, in a limited way, Emerging Cooperative members are assuming a greater leadership role in sensitizing the civic responsibilities of the total community. This is observed with a greater interest on the part of elected officials relative to the needs of the residuals of affluency. Despite such concerns of elected officials, the movement is faced with a situation in which a large number of the members are outside the political mainstream.

Big business and big cooperatives (established) are self-centered. Most of them have been rather successful in meeting the needs of the affluent Americans [11]. On the other hand those Americans classified as residuals of affluency must share in the remnants of that society.

A brief review of the early years of the political thrust of the Emerging Cooperative Movement brings two fallacies to surface. First, too much responsibility was delegated to the residuals of affluency for winning the poverty war. The blind cannot lead the blind. And second, the "community oriented" thrust of the Emerging Cooperative Movement for involving people in the poverty war was overemphasized. Getting people aroused about improving their plight is one thing, having the sophistication for orchestrating all elements necessary to develop and implement community improvement programs is another. The sophistication for developing the leadership ranks of the Emerging Cooperative Movement was lacking. In too many instances, the leadership was required to design and implement political strategy without the support or the cooperation of the Established Cooperative leadership. Board members of the Emerging Cooperatives experienced difficulty in projecting their leadership qualities to gain community support

Despite the limitations of the Emerging Cooperative Movement, there has been an apparent diminishing resistance from the establishment and the community concerning the movement's political thrust. There seems to be a mutual feeling of respectability and a greater willingness to lend assistance.

Another major spin-off from the early political experiences of the Emerging Cooperative Movement is reflected in the increased community pride on the part of the membership. The Emerging Cooperative membership working concurrently with other Great Society programs, Model Cities and Community Action, brought into sharp focus the realization of what democratic government is all about—a government of the people and by the people. The combined thrust of the Great Society programs helped to rekindle hope in the future of democracy. We have observed the demand for additional responsibilities by the Emerging Cooperative leadership in community development. Members of the movement are working with other groups to assure that the fruits of our affluent society are shared equitably.

With the trend toward the use of revenue sharing for community development programs, a strong, sophisticated Community Action group is necessary. A community void of such support and sophistication will find it difficult to influence the use of revenue sharing funds or programs.

The results of Southern University's involvement in outreach services demonstrate the need for a mechanism designed to provide civic education to individuals with the characteristics of Emerging Cooperative membership [15]. Institutions such as Southern University are uniquely qualified to develop and to implement such a mechanism. Southern University, like the other original sixteen 1890 Land Grant Colleges established by the second Morrell Act, has the specific responsibility of providing training for people of color [7]. These colleges have the orientation and the experiences of disseminating information to the residuals of an affluent society. Adequately funded, the 1890 Land Grant Colleges could bring about greater civic awareness between the Emerging and Established Cooperative membership and the Land Grant College Complex.

Established Cooperatives have the experience of manipulating politics to the advantage of their membership. This fact was observed by some recent public disclosures. The 1892 Land Grant Colleges which were established by the first Morrell Act have a proven record of assisting the Established Cooperative membership in their development efforts [7]. However, effective mechanisms to articulate the needs and to effectuate the solution to the needs of Emerging Cooperative Movements leave much to be desired.

Economic Thrust and Educated Awareness

The Emerging Cooperative Movement must never become so involved with the working of politics that it loses sight of the economic needs and aspirations of people. Through the years, the leaders of the movement have been concerned with the utilization of all resources to improve the quality of life for its members, who desire a dignified job and a home with the other basic necessities.

One could convincingly argue that the services and support needed by the Emerging Cooperative membership to assure economic viability are available for the asking and that the failure of the Emerging Cooperative Movement to utilize such services is due to the inability of the Established Cooperative members to conceptualize what is needed by the Emerging Cooperative Movement. Certainly some merit can be given to this position. However, economically speaking, members of the Emerging Cooperative Movement understand what is required of them to make their cooperative economically successful. Likewise, the members are committed to the cooperative principles. In addition, Emerging Cooperative members are desirous of helping their organization become economically viable and sensitive to the membership needs. The missing link in the Emerging Cooperative Movement is that these goals have not been realized.

Some of the criticism waged against the lack of economic thrust incorporated in the activities of the Emerging Cooperative Movement is reflected in the inability of the membership to conceptualize what a cooperative is all about. The textbook presents cooperatives as an organization whereby people pool their resources to accomplish collectively what they cannot do individually. While most textbooks on cooperatives view them as an economic entity, the typical Emerging Cooperative has all the textbook characteristics—one man, one vote, and services at cost—other than a cooperative.

Specifically, Emerging Cooperatives have the following characteristics: (1) short history of operation as a legal entity—many of these cooperatives do not have a charter, even though they have been in operation for an extended period; (2) limited membership loyalty—only a few Emerging Cooperatives can depend upon membership for purchase or sale supports; and (3) realized limited savings for the membership —a relatively small number of Emerging Cooperatives have paid patronage dividends, and fewer still have realized any significant savings, real or otherwise, for the membership [16].

Most Emerging Cooperatives are operating on borrowed money and borrowed time with both at the termination point. Promise of realizing economic goals or objectives by the leadership of the Emerging Cooperative Movement must be supported with actual accomplishments.

Even though the Emerging Cooperative Movement has realized little economic success for the membership, the mere recognition of such a possibility by the residuals of affluency is encouraging. This is significant when it is recalled that members of the movement have come together at a difficult time to help each other in a manner that most critics will accept as the "American way." A growing number of Emerging Cooperative leaders are insisting that the Land Grant Complex assume a more active role in helping their membership in the pursuit of economic goals.

Gaining increasing support among the Rural Emerging Cooperative leadership is the feeling that the family farms should be consolidated under a cooperative arrangement. However, more data should be collected and analyzed concerning the social and economic impact of consolidation of family farms under a cooperative umbrella before any position is advanced. An aggressive economic thrust of the Rural Emerging Cooperative Movement has been to serve as a catalyst to preserve the economic viability of the family farm, and this should continue as its major goal.

Southern University researchers are attempting to appraise what it is that makes an economic family farm unit. From preliminary findings two factors stand out: the type and combination of farm enterprises and the affiliation the operator has with successful cooperatives when purchasing inputs and marketing farm outputs. In other words, the Established Cooperative with proven purchasing and marketing techniques plays an important role in determining the economic success of a family farm.

We at Southern are convinced that the Rural Emerging Cooperative Movement has the potential for providing leadership to assure the family farm, even though individual cooperatives have not assumed an economically successful track record. Likewise, we are of the opinion that the realization of the Rural Emerging Cooperative Movement assuming a greater role in preserving the conventional family farm is directly related to the support the movement receives from the Land Grant Complex in general and the 1890 Land Grant Colleges in particular. To support this observation, one has only to review the development of the Established Cooperatives.

The economically successful cooperatives today were at one time relatively small. The social, political, educational, and economical climates out of which these early cooperatives flourished commanded unqualified support from the Land Grant College Complex. Turn the coin over and you observe an entirely different set of conditions confronting the Emerging Cooperative Movement during its formative years.

The Emerging Cooperative Movement with limited know-how, funds, and practically no support from the Land Grant College Complex had to fight against many odds in an effort to play a meaningful role in community development. In fact the Emerging Cooperative Movement was at a disadvantage in competing with the so-called Established Cooperatives for the technical services located at the Land Grant Complex.

In the wake of the conditions under which the Established and the Emerging Cooperatives developed, a number of Emerging Cooperative members are of the opinion that neither the Established Cooperative leadership nor the Land Grant College Complex fully support their efforts to become economically relevant in their community development thrust. They argue that through the years, thanks to the Land Grant Complex, Established Cooperatives have acquired a reservoir of know-how and loyal support from the Land Grant Complex that could be shared with the Emerging Cooperative Movement with limited adverse effect on the economic thrust of Established Cooperatives.

The experience of Southern University with the Emerging Cooperative Movement has convinced us that the machinery for sharing tested approaches for community development is strongly needed. We are equally convinced of the potential for Emerging Cooperatives exerting an accelerated impact on community development. Greater utilization of the 1890 Land Grant College resources for assisting the Emerging Cooperative Movement to become economically viable should be encouraged.

The 1890 Land Grant Colleges with adequate federal funding could fully apply their demonstrated techniques in community development. An aggressive Emerging Cooperative Movement would mirror the economic thrust of the family operators while the already committed Established Cooperatives would continue to serve as the spokesmen for commercial agriculture. Both the Emerging and Established Cooperative Movements could draw upon the resources located at the Land Grant Complex (1890 and 1862 Land Grant Colleges) in their efforts to improve the quality of life for the membership.

Although our education system must continue to strengthen community development through research and outreach efforts, the membership of Emerging Cooperatives has limited knowledge about how our capitalist system operates. This factor alone accounts for much of the noneconomic orientation of the Emerging Cooperative Movement. There is a reservoir of expertise available in the Land Grant College Complex for correcting this problem, but what is needed is a mechanism for matching needs with available resources.

In order for a cooperative to be successful, it must be under good management. Established Cooperatives recognize this importance of management in that millions of dollars are spent yearly for the training of managers who have grown up in the movement. On the other hand, managers of Emerging Cooperatives have had limited management training and the Board budget has few funds for such training. This is significant in that some managers and other officials of the Emerging Cooperative Movement have limited management training while a number cannot read or write.

The 1890 Land Grant Colleges could be that focal institution the Emerging Cooperative members turn to for research and training. These colleges already have underway research and training on how to organize and train grassroot leaders for community development. With additional federal and state funds, these efforts could be expanded.

Training needed by Emerging Cooperatives is similar to that of Established Cooperatives, but the content and delivery methods are different. For Emerging Cooperatives the delivery should be close to a one-on-one basis and offered by trainers who are sensitive to the aspirations of the participants.

In order to provide such specialized training, there should be developed a number of training centers at the 1890 Land Grant Colleges. Locating the Centers at these Colleges would provide technical assistance to the Emerging Cooperative Movement on a continuing basis and serve to utilize the proven expertise of the 1890 Land Grant Colleges in community development. During the implementation of the education thrust, the research and outreach programs underway at the 1890 Land Grant Colleges will undergird the technical assistance provided by the Center's staff.

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Session 2

THE ROLE OF COOPERATIVES IN FUTURE AGRICULTURE

Discussants: C. Phillip Baumel, Iowa State University; Ronald Bird, U. S. Department of Agriculture, Economic Research Service, Washington, D. C.

Session 3

FOREST ECONOMICS

CHAIRMEN: EMMETT F. THOMPSON AND JOHN E. WALDROP, JR.,

MISSISSIPPI STATE UNIVERSITY

Economic Trade-Offs in Multiple-Use Management of Forest Lands*

MARION CLAWSON

"MULTIPLE-USE" is a term with great emotional appeal, but it is more a slogan than a management guide, and its meaning often varies according to the user. If one implies that every conceivable use of forest land should occur on every acre every year, multiple use is impossible, even nonsensical; if one means that some uses can be accommodated to some other uses on the same land at the same time, there exists more but still rather limited possibilities; but if one means that various uses can take place on closely intermingled tracts of land at the same time, or on the same land at different times, with the whole management area managed for multiple uses, then the possibilities widen greatly. There is great need to give "multiple-use" some operational content, and hopefully this paper is a modest step in that direction.

First of all, we must realize there is an enormous variety of forest situations in the United States. Taking into account major forest types (the Forest Service recognizes 20; for some purposes I have compressed these into 14), several major regions of the nation (however these are defined), five productivity site classes, at least four major ownership categories, and several stocking types and volumes, I have concluded that there are at least 4,000 forest situations in the United States significantly different as to management possibilities or purposes. For some purposes it is as valid to generalize about "forests" as it is to generalize about "farms" or factories or schools; but for many purposes it is necessary to distinguish carefully among these many different forest management situations. In this paper, because of space limitations, I shall generalize at a level which would be unacceptable if one were trying to work out a management program for a specific forest type, in a specific location, with certain site qualities and existing timber stand, and for an owner with specific goals, objectives, and limitations.

For our purposes, forests have four major characteristics or attributes (Table 1). All forests occupy land, and land is essential to each of the uses shown in the Table; while uses might be defined differently by other workers, any definition of forest uses will reveal land area as a necessary characteristic for each use. Forests also have timber stands, which may range from zero on a recently cut or burned tract to the biological maximum the site will support, in a mature stand not reduced recently by fire, insects, or disease. Timber stand volume has a different significance to the different uses of the forest; wood production requires a thriftily growing stand, neither the very low volume of a poorly stocked stand nor the maximum volume of a mature stand on which net growth approaches or reaches zero; in contrast, wilderness use requires the maximum volume the site will support as a natural timber stand, but some wilderness areas have no commercial timber on them. Active outdoor recreation is generally more pleasant on a forested than on a nonforested site, but a light and open stand is likely to be more attractive to most users than is a dense stand. As the table indicates, other uses have other requirements for timber stand.

Annual growth, the third major characteristic of forests, also has differing significance for the

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* This paper draws heavily upon a book length manuscript in press at Resources for the Future [1] and upon [3], which grew out of a recent forum on forest policy, held under Resources for the Future sponsorship. Readers should also refer to [2] for specific data as well as for analysis.

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Table 1. Interrelations of forest characteristics and forest uses

	Relationship of the forest characteristic to the following forest uses						
Forest characteristic	Maintain attractive environment	Provide recreation opportunity	Wilderness	Wildlife	Natural watershed	General conservation	Wood production
Land area	Essential	Essential	Essential	Essential	Essential	Essential	Essential
Timber stand volume	Modest stand attractive, but most productive stand not required	Moderate importance; open stand often more attractive than full stand	Volume at maximum site will produce but actual volume unimportant	Kind and numbers of wildlife responsive to stand characteristics	Important to have good cover but timber volume of limited importance	Helpful to have good cover	Thrifty growing stand essential; too small or too large volume reduces growth possibilities
Annual growth	Not very important	Limited value	Unimportant; in practice, often close to zero	Limited importance	Relatively unimportant	Relatively unimportant	Critical for long run rate of harvest but growth rate also dependent upon harvest
Annual harvest	Inimical but careful planning and operation can reduce impact greatly, and may enhance appearance in some instances	Possible under carefully controlled conditions and on rotation	Unacceptable; destroys basic value of experience	Acceptable under proper controls; desirable for some species	Acceptable under proper controls	Acceptable under proper controls	Critical both for use of wood and for its further growth

different forest users. Wood production depends, in the long run, on wood growth; in contrast, annual growth is of limited importance to the other major uses, if adequate timber stands are present; in a wilderness area, if the stand is really at the natural stand maximum the site will support, then net annual growth is zero. Annual harvest of timber, wildlife, or even recreation opportunity is the fourth major characteristic of forests. This is, of course, critical to wood production, for it is harvest which produces income; harvest is also often an important point in the life cycle of the forest at which management practices can be applied; and, in the long run, harvest is critical to timber growth. A forest landowner cannot long cut more timber than he grows, for at some point he uses up all his inventory; but equally he cannot grow for very long more than he harvests, for in time inventory reaches a level from which no more net growth is possible. In sharp contrast, timber harvest is completely antithetical to wilderness preservation and use; it is, or can be made, acceptable to most of the other uses, if proper and adequate measures are taken in the timber harvest to reduce adverse impacts on other uses.

Table 1 is in very general terms applicable in large degree to all forests. The relationships between uses and characteristics are more physical than economic, although they have economic implications. Different forest owners, with different objectives or purposes in ownership, might well utilize these interrelationships differently. The requirements of the differing forest uses suggest some possibilities for reconciling their apparent conflicts.

The forest uses shown in Table 1 have differing degrees of compatibility or conflict with other possible uses (Table 2). The greatest incompatibilities exist between wilderness, moderately intensive outdoor recreation, and timber harvest. Wilderness is completely incompatible with the other two; timber harvest destroys the undisturbed ecological system which the wilderness lover values so highly, but intensive recreation as surely destroys the character of the wilderness experience. Limited compatibility exists between timber production and recreation (other than wilderness); some such recreation, especially hunting, can take place on cutover areas, may indeed be facilitated by timber harvest; and some timber harvest may take place on recreation areas, either by carefully managed cutting or by rotation of recreation sites, such as campgrounds, and timber harvest areas.

The other uses of the forest generally range from moderately to fully compatible with each of these three "incompatibles," if adequate measures are taken. Timber harvest, for instance, can be so conducted as to avoid severe disturbance to watershed and to stream flows, both quantity and quality; or to reduce greatly the aesthetic shock of harvest; or to maintain, and sometimes to improve, the wildlife habitat. Wilderness, while incompatible with timber harvest and intensive outdoor recreation, maintains watersheds in natural conditions and is favorable to many kinds of wildlife.

Table 2. Degree of compatibility among various forest uses

Primary use	Maintain attractive environment	Provide recreation opportunity	Wilderness	Wildlife	Natural watershed	General conservation	Wood production and harvest
Maintain attractive environment	—	Moderately compatible; may limit intensity of use	Not inimical to wilderness but does not insure	Compatible to most wildlife, less so to a few	Fully compatible	Fully compatible	Limited compatibility; often affects amount of harvest
Provide recreation opportunity	Moderately compatible unless use intensity excessive	—	Incompatible; would destroy wilderness character	Incompatible for some kinds; others can tolerate	Moderately compatible; depends on intensity of recreation use	Moderately compatible; incompatible if use too heavy	Limited compatibility depends on harvest timing and intensity; roads provide access
Wilderness	Fully compatible	Completely incompatible, cannot tolerate heavy use	—	Highly compatible to much wildlife, less so to others	Fully compatible	Fully compatible	Completely incompatible, precludes all harvest
Wildlife	Generally compatible	Limited compatibility; use intensity must be limited	Mostly compatible though some wildlife require vegetative manipulation	—	Generally fully compatible	Generally fully compatible	Generally limits volume or conditions of harvest
Natural watershed	Fully compatible	Moderate compatibility; may require limitation on intensity	Not inimical to wilderness but does not insure	Generally compatible	—	Fully compatible	Moderate compatibility; restricts harvest methods but does not prevent timber harvest
General conservation	Fully compatible	Moderately compatible; if use not excessive	Not inimical to wilderness but does not insure	Generally compatible	Fully compatible	—	Compatible but requires modifications in methods of timber harvest
Wood production and harvest	Compatible if harvest methods strictly controlled	Moderately compatible	Completely incompatible; would destroy wilderness	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	—

Neither table shows certain land uses which may occur on forested sites but do not really use the forest. Highways and transmission lines are good examples; so is mining. Even grazing, which may take place on a forested area but mostly utilizes vegetation other than the trees, may be an example of this kind of use. So may the "second home," which utilizes the trees of the forested tract about as the suburbanite utilizes the trees on his lot. While these uses do compete for forest land, they are largely irrespective to the forest—indeed, for them, the forest is frequently a liability, something to be gotten rid of.

Transformation Functions

The foregoing type of analysis is suggestive but inadequate for the economist; it is too subjective, verbal when it should be quantitative, and does not recognize that the nature of the relationship between outputs depends to some degree on the scale of one or the other. The economist needs, as a first step, transformation functions—when the output of some product or use is increased, what effect does this have on the output of some other output or service of the forest? Even when outputs are generally compatible, they are often not in fixed proportions; and when compatibility is more limited, the trade-offs between more of one output and less of another become more important.

For instance, wildlife specialists often talk about leaving unharvested some old trees, often snags or "wolf trees," frequently malformed for conversion into lumber, which may be vital to some species of wildlife. But how much wildlife, of what kinds, are so produced? Is the production of some wildlife increased while that of others is decreased, and, if so, how much? How much loss, of what kinds, and on what time scale, would such measures mean for the production of wood? Or, to take another example, it is often urged that trees along streams or around lakes be left unharvested, to provide shade over the water and a screen of vegetation against erosion, when a major timber harvest is undertaken. But how wide a belt of unharvested trees should be left? What is the risk that wind will bring them down, and thus perhaps cause more damage to the quality of stream flow than if they had all been harvested in the first place?

Can the reserved trees later be harvested without ill effect? Or may it become uneconomic to go back for their comparatively small volume? In other words, how much water quality is obtained at how much loss in wood output, now and for what time stream in the future?

This type of example, of trade-off of one output for another, in the mix of outputs from the forest, could be multiplied many times. Obviously, the nature of the trade-off would depend upon forest type, site class of the area, present condition of the stand, and many of the other variables briefly mentioned above. The trade-off may depend on the volume of one or more outputs—one effect of timber harvest upon wildlife when the volume of timber harvest is low, another effect when it is large, and so on. I am now talking about physical trade-offs; the valuation problem is discussed later. Some information exists on these physical trade-offs, but often it is woefully weak. To use the examples above, the wildlife specialists or the watershed specialists can often prescribe the measures they think are needed for a desired degree of output of the service they are interested in; but only rarely can they provide information as to what is given up thereby—they are likely to prescribe certain rules, more or less absolutes, without specific information on trade-offs.

But the economist also needs information on input-output relationships for each kind of forest output. Inputs of labor, capital, and entrepreneurship are needed for forest management, for any forest output or combination of outputs. The management of the forest may be extensive, ranging from virtually no management beyond periodically cutting everything on the site that can be run through a saw profitably, to various measures designed to improve the future stand by selective cutting of the present stand or by insuring in various ways natural seeding of young trees on a site after harvest. The various extensive forms of forest management mostly involve manipulation of "natural" stands of trees—"wild" trees, which seed by their own efforts, at their own spacing, no thinning by man but only by the natural forces of competition for sun and water, and so on. Extensive forest management includes comparatively low quantities of inputs.

Various gradations in intensive forestry are available. For instance, genetically superior seedlings can be grown and planted, and the natural reproduction of unimproved stands suppressed or replaced by the prompt planting of the improved seedlings. Trees in almost every forest stand are, by and large, extremely mixed in genetic makeup; the competitive process whereby hundreds or thousands of small seedlings grow into a comparatively few mature trees per acre often eliminates most of the "unfit" seedlings. But genetic improvement by sheer selection of superior individuals, permitting them to reproduce, and using their progeny for another round of selection—a process which was once highly important for farm crops, but which is now largely unproductive there because most of its gains have been achieved—is thoroughly practical for forestry today. Various ingenious ways have been devised to identify the superior individuals when they are mere seedlings, and various other ingenious methods of speeding up reproduction are now being developed, to speed up greatly the process of genetic improvement.

Intensive forestry includes far more than selection of genetically superior seedlings. Planting to attain a desired degree of stocking, precommercial and commercial thinnings at appropriate intervals, fertilization in some cases, sometimes eradication of "weeds," and other measures may increase wood production greatly. These measures are likely to be much more productive in combination than when taken singly; there will likely be less response to fertilizer on a lightly stocked stand than on a fully stocked one, for instance. Intensification measures are likely to increase annual wood production per acre more or less proportionately on forest sites of various productive potentials, but the absolute amount of the increase will be far higher on better than poor sites. The Forest Service and other foresters often employ a five-fold site classification, dependent upon the ability of a "fully stocked natural stand" to produce wood annually. Site Class I can produce 165 or more cubic feet per acre annually; Site Class V can produce only from 20 to 50 cubic feet of wood annually. This classification is wholly in physical terms; it takes no account of the value of the wood per cubic foot nor of the costs of harvesting it. A package of intensive forestry practices may double annual output per acre, but this may mean only 35 extra cubic feet of wood on a relatively poor site and as much as 175 cubic feet of wood per acre annually on the best site—and at per acre costs or inputs not too greatly different.

Information on input-output relationships is best for wood production, although it is less complete here than would be desirable. Presumably, similar information could be developed for each of the other outputs or services of the forest. A basic item of needed information is a site classification for each output; for instance, how would a wildlife specialist classify a forest for its ability to produce some species of wildlife, both as a natural forest and as a managed one? And how would the classification for wildlife production compare with the classification for wood production—would the most productive wood producing sites also be the most productive wildlife sites? How might one increase the numbers of some desired wildlife species, and what effect would these management practices have on other wildlife or upon other outputs of the forest? One can multiply this wildlife example for every forest use shown in the tables and for every combination of two or more uses.

Economic Efficiency

For the economist, information on the physical trade-offs and physical transformation functions is a natural prelude to an economic analysis, and it is the latter which is truly significant. Does a 50 percent increase in wildlife production from some area have more value than a 1 percent reduction in timber output, assuming that this might be the physical trade-off in some area? For economic calculations, information on markets, prices, and costs are necessary; because of the time dimension of most forestry, interest or discount rates assume unusual importance. Benefit-cost ratios and absolute margins between benefits and costs can be calculated for different scales of intensity of management, different mixes of outputs, and other different conditions. This is familiar subject matter to economists; it is not necessary for me to explore it here today, and I prefer to use my limited time and space to consider other aspects of the multiple use forestry problem.

One problem, however, is rather more difficult for forestry than for many other resource management situations. A great many of the outputs of the forest listed in Tables 1 and 2 are not sold on a market, hence it becomes necessary to estimate shadow prices of their outputs. This, too, is a complex problem about which economists have been increasingly concerned in recent years, but I do not choose to explore it today. Sometimes, when the valuation problem becomes intolerably difficult and the results of various approaches have impossibly great dubiousness, one may resort to cost effectiveness approaches with better sense. Without attempting to measure the value of a minimum breeding stock of grizzly bears in some forest situation, for instance, one might calculate the cheapest way of achieving this end, and thereby provide information to rule out some method of forest management designed to achieve the result of maintaining a viable breeding stock of grizzly bears.

Compared with many other resource management problems, forest management presents two somewhat different or somewhat more than usually difficult problems. In the first place, wood is both output and capital; when the tree is cut and the log marketed, the wood is output; when the tree is allowed to grow another year or longer, the same wood is capital, or productive equipment. By whatever method of analysis one seeks to decide whether to harvest a tree this year or in the future, a major item of cost in growing more timber is the interest that might be earned from investing elsewhere the capital which could be obtained by cutting the tree. The bigger the tree gets, the more capital is tied up in it, all else being equal, and the culmination of mean annual growth, which is often the forester's standard for forest maturity, occurs long after the culmination of rate of return (current growth over stand volume). In some forests where the annual rate of growth is low, both in cubic feet per acre annually and as a percentage of standing wood volume, the most economic management practice is to cut as soon as a minimally economic volume for harvesting has been attained.

The other problem, not unique to forestry in kind but nearly so in degree, is the trend in output prices. When a forest management decision is under study, a relevant fact is the price or value of the outputs when they are ready to be sold. Lumber prices in the United States have advanced for nearly two centuries, at an average rate of about 1.8 percent annually, compounded. But this average rate of advance has included periods of several years when lumber prices were fairly steady, as well as periods when lumber prices moved up very rapidly. Stumpage prices have moved upward as much, or more, than lumber prices. Seedlings planted today are likely to be marketed some day as logs at prices far above log prices today, but the precise date of marketing may greatly affect their prices. It is often argued that the value of wilderness is moving upward even faster than is stumpage price. We have no generally accepted value or price data on wilderness today, much less on economic value of wilderness at some past dates, hence quantitative calculations of trends in wilderness value are impossible, and we must perforce rely on logic or argument.

Equity or Income Distributional Effects

Although economists were long content to calculate benefit/cost, each as a single total, I regard this as unacceptably incomplete for policy decisions today. Even if the benefit-cost calculations are impeccable, and even if they properly show the total social cost and the total social benefit, this does not touch the difficult and slippery matter of who pays the costs and who gains the benefits. As a matter of fact, in forestry there is a large disassociation of costs and benefits. The forest owner, whether public or private, gains nothing from the value of the water which flows off the forest land, irrespective of its value and irrespective of the costs he may have incurred to maintain the watershed in desired condition; wildlife in forests rarely provides any income to the forest owner, however great the value to society may be; much outdoor recreation is provided free or at charges far below either cost to the forest landowner or value to the recreationist; those who enjoy the aesthetic values of forest rarely pay much of the cost incurred in preservation of those values. The disassociation of costs and benefits is not only between persons, and often between social groups, but also between a local area and a national interest.

Social scientists have not yet invented, and probably never will invent, a simple measure of income distributional effects, such as benefit-cost is for economic efficiency. Among other problems, that of comparing costs and gains for different individuals gets into interpersonal comparisons of utility or value; is the gain to the local economy from operation of a sawmill which harvests timber from a potential wilderness area more important than a national gain from the wilderness, assuming that the monetary values of each could be measured in a way everyone would accept and that the values were equal? Though we as economists cannot answer such questions with any assurance, it seems to me we have, as a minimum, an obligation to make all the facts, or as many of the facts as we can find, available to the decision-maker, whether he be public land manager, politician, or private landowner. To me, who gains and who pays is as critical a lot of information as how much value at what cost.

Social or Cultural Acceptability

Measurement of the economic efficiency of different physically practical forest management programs, and estimation of the income and cost incidence of each, will generally not be enough for forest policy decisions. We, or someone, must also consider the cultural or social acceptability of each proposed management alternative. Today, for instance, large numbers of people will reject a forest management program of letting fires burn uncontrolled, even if benefits to be gained from fire control do not equal costs; large numbers of people have reacted strongly against allowing slash and waste from harvested sites to rot naturally, because they find its appearance offensive and are not moved by silvicultural or economic analyses of its efficiency as a forest management practice; clearcutting has become an emotional issue, largely without respect to its silvicultural or economic aspects; and one could go on, listing other issues in forest management where cultural or social attitudes are important if not dominant.

I include here attitudes other than, or in addition to, those which show up in value estimates. The value of any forest output is largely an expression of human attitudes toward it; if people thought less highly of wilderness or of outdoor recreation, then a reasonable value estimate would be lower than if they thought more highly of it. But I think that every society has certain standards of social acceptability for which it is extremely difficult if not impossible to attribute any economic value; some things are simply not done, or others are simply necessary in a civilized society, and cost-benefit is not the criterion. Attitudes may and often do seem irrational to those who do not hold them, and they may change over time—and economic profitability can be a powerful force toward change; but, while the attitude persists, it may be as powerful a constraining force upon the forester as is the species, age, volume, and other characteristics of the present stand of timber. No small part of the forest controversies of recent years has its origin in the (largely unconscious) neglect of social attitudes by foresters.

Administrative or Operational Feasibility

A final aspect of multiple use forest management must be the administrative or operational feasibility of the program proposed. Two illustrations may make the point: oftentimes a forest management program on a small privately owned forest would be physically practical, economically efficient, the bearer of the costs would secure the gains, and the suggested program is culturally acceptable; yet the program is not carried out; why? The answer, practically, lies in the fact that the small private owner simply lacks the managerial capacity, and is unable to hire it, to accomplish the desired management program. Secondly, various programs might be devised for national forests which also met all the foregoing tests, and yet could not be carried out, either because the agency is precluded by various bureaucratic restraints from practicing economic forest management or is not provided with adequate funds to implement management decisions.

The forester, the economist, and everyone else concerned with forest management must take the capacity of the management organization into account in his analysis and into his recommendations for forest management. I am not talking here about goals in forest management; the small private forest owner may choose not to harvest any trees because he likes to look at the forest as it is, but many a small private forest owner who would like to harvest some of his trees, or to carry out some other forest management practice, is simply unable to do so for lack of administrative or operational capacity. Most managers of public forests would like to do many things which they are unable to do. One may argue, as I have, that many of the programs foresters would like to carry out are dubious on the grounds of economic efficiency, distribution of economic costs and returns, or social unacceptability; but, even when these tests are met satisfactorily, operational capacity may still be the governing constraint on actual multiple use forest management.

Scale for Application of Multiple Use Forest Management

At what scale should multiple use planning, multiple use management, and trade-offs in multiple decision-making of forests be employed? It is tempting to answer: at the scale at which the decision-maker must make decisions—the individual property for the small private forest owner, the whole forest property for the larger industrial forest owner, the unit of administration (forest, ranger district, etc.) for the public forest manager. Such an answer is correct but incomplete. Multiple use analysis, planning, and operation must indeed take place at this scale; most of the literature on multiple use forestry is concerned with this operational unit scale. The problem is to reconcile one use with another, to decide upon the scale of each, to find and implement programs which reduce conflict—and all with regard to the criteria of physical practicality, economic efficiency, distribution of economic gains and costs, social or cultural acceptability, and administrative or operational feasibility which I have outlined in this paper. To the extent multiple use forestry is practical on this scale, it realizes the potential of the area concerned.

But I think that multiple use forestry must be approached on a national scale also, and it is here that the enormous variability among forests in the United States, briefly mentioned at the beginning of this paper, is so important. We know a great deal more about the wood-producing attributes of our forests than we do about their ability to produce any other output, hence my illustrations will focus on wood production, but if data were available a similar analysis could be made for the other outputs of the forest.

In 1970, according to Forest Service estimates, all the commercial forests of the United States grew 18 billion cubic feet of wood; if all stands had been producing at their potential for fully stocked natural stands, growth would have been just double, or 37 billion cubic feet of wood. We do not know how much of the actual growth took place on forest sites of different productive capacities, but only 12 percent of the potential growth could take place on the 27 percent of the commercial forest acreage classified as Class V sites—those capable of producing only 20 to 50 cubic feet of wood per acre annually. I have elsewhere expressed doubt that these Class V sites, by and large, can really be considered commercial forest lands—their annual output is too low to justify the necessary costs of growing wood on them. An economic classification of forest sites might reveal some of these forests as supramarginal, but it might equally reveal some Class IV sites as submarginal. Many of the poorer sites in public ownership still have accumulated volumes of timber, the result of centuries of nonforestry before white man settled the North American continent, and these accumulated volumes can often be harvested at a profit to the harvester, if we choose to make them available for this purpose; but more timber cannot economically be grown on them.

Had all the forest lands, of all site classes and all ownerships, been managed intensively for wood production, annual growth would be nearly double that possible under full natural stocking —68 billion cubic feet per acre annually, I estimate. Some of this wood growth would be uneconomic under probable future cost-price relationships, but much of it on the better sites would be economic. We have estimated (in the sources cited at the beginning of the paper) supply curves for wood growing, on sites of different productive capacities and under different intensities of management. I have set up a very rough national model of high-intensity low-harvest-acreage, which takes into account annual output of wood per acre, annual and periodic costs per acre, assumed objectives and organizational limitations of different classes of owners, and—above all—productive capacity by site class, which could grow more than 22 billion cubic feet of wood annually on less than 40 percent of the commercial forest land (as the Forest Service defines the latter)—and do so economically. This type of intensive forestry on some sites would have some repercussions on the other outputs of the forest from these lands; such effects could be greatly reduced if not eliminated by careful management practices. More importantly, more than 60 percent of the assumed commercial forest acreage could be used for purposes other than wood growing and wood harvest: wilderness, intensive recreation, specialized watersheds, specialized wildlife production, and others. Much of the latter would be hardwood forests in the East and South, which produce relatively little wood annually per acre and/or produce wood of species not in high demand; these forests are located conveniently for millions of urban dwellers and could produce services in high demand, including restored "wilderness."

I do not expect, and indeed I do not advocate, that American forest management go to the extreme of this high-intensity low-harvest-acreage model; but I do say it could and should go a considerable distance in this direction. Over the past 100 to 200 years, farming has greatly intensified operations on the best lands, at the intensive margin of cultivation, and has simultaneously retreated from extensive areas once cultivated, at the extensive margin of cultivation. I expect American forestry in the next generation or two to move substantially in the same direction. As I see it, forest economists have a major responsibility in pointing out the direction of future forestry to foresters, to legislators, to property owners, and to the many conservation groups. We surely need to make many studies, more innovative and more imaginative than we have made in the past, to point the way. It is my considered judgment that economists, as a group, have greater competence to do this than any other single professional group—not that we can do it alone, by any means, or even do the half of it, but we can surely supply some critical ingredients.

Forests of all types, all site classes, all ownerships, in all parts of the country could thus be fitted into a truly national system of multiple use forestry.

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Timber Supply: Goals, Prospects, Problems

WILLIAM A. DUERR

IN TIMES OF INFLATION, supply is a current issue, and so it is with timber.[1] But timber supply is more than a current or a recent concern: it is an old—even an ancient—problem.

Supply in the Long Term

In the earliest civilizations where wood was a staple, people were continually in fear of running out of it, because they were cutting what was at hand, its regrowth was slow, and the transportation of more was difficult if much overland distance was involved. Predictably, it was in the landlocked German states in the thirteenth century that the specter of timber scarcity became so persistent as to goad the rulers into passing preventive ordinances and founding a forestry profession to enforce them [14]. In mid-seventeenth century, at the end of the devastating Thirty Years' War, population was growing steeply, and industries were becoming prominent: mining and the processing of minerals; glass and china manufacture; the making of charcoal, potash, and resin derivatives. Every one of these activities used wood as an input. The doctrine of mercantilism was at large, and huge quantities of wood were floated down to the seaports for shipbuilding in pursuit of export trade [9, p. 21]. Foresters, who by then were managing forests for wood and other resources, looked around them at the exploitation and preached that there would be a timber shortage and that only a policy of sustained yield could avert disaster. The threat of famine and the necessity for sustained yield became two of the tenets of faith of the forestry professional subculture [12]. That was decades before the time of Thomas Robert Malthus's Essay. The old tenets of faith were echoed in the teachings of America's forestry fathers, Bernhard Fernow [15, 35] and Gifford Pinchot [28], and are reechoed today in the thinking of foresters and of many others as well.

The notion of impending timber scarcity is not altogether ridiculous. The world's physical inventory of timber has shrunk steadily over the centuries. Real prices of timber generally have risen. Consider our western softwood mainstay, Douglas-fir, on the national forests. Before the turn of the present century, it was essentially without market value. Speaking in terms of constant 1967 dollars per thousand board feet of standing timber, the average price was about $2 at the time of World War I, $4 just before World War II, and $8 immediately thereafter. It had cleared $16 by the mid-1950s and $32 by the mid-'60s [49, p. 332]. It completed still another doubling a year or two ago.

Paper, which is produced by a heavily concentrated industry, has had a relatively circumspect price history. But take the case of lumber, which is the undifferentiated product—a rather heterogeneous product—of a highly fragmented industry, long the dominant user of wood. Its prices are notably sensitive to resource conditions. If one searches out wholesale price data for the United States since the 1790s, deflates the index with an all-commodity average, and carries out the necessary splicing of successive series, he finds an amazingly consistent long-run upward trend of nearly 2 percent annually [19, pp. 17–18]. The trend appears to be somewhat the result of raw-material cost trends and greatly the result of lagging technology in the conversion of standing timber to end products—that is to say, it is evidence of a supply problem, a scarcity problem [60, pp. 179–181; 61, pp. 517–519; 62, p. 596].

The long trend of lumber prices has comprised bursts in which real price has risen at an annual rate of 5 to 10 percent or more during a period of 2 to 5 years or so, interspersed by calm periods as long as 30 years when the yearly rise was averaging perhaps one-half percent or less. That is to say, the long-term up-sloping graph is formed of a series of near plateaus situated at successively higher elevations by virtue of the steep cliffs connecting them.

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[1] "Timber" refers to standing trees as sources of wood, whereas "forest" refers to biological systems involving trees for wood or for other purposes, such as scenery. Logs, lumber, plywood, paper, and other commodities derived from the substance of trees are referred to collectively as "timber products," or "wood products."

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Short-Term Supply Crises

Lumber's real-price bursts have occurred, with only a couple of exceptions, in the aftermath of all our major wars since the Revolution. The circumstances, at least of the earlier bursts, have not been studied in depth, but in general one may surmise that unusual demands for housing and other coniferous wood products encountered sluggish supplies of harvestable timber and of timber-conversion capacity [34, pp. 37–39; 17] and that prices, once elevated, were held at their new level because pent-up labor and entrepreneurial costs had rushed in to claim the proceeds.

As for unusual demands, one can take housing starts as a reliable indicator and study a couple of instances [55]. Before World War I housing was being started at the rate of about 400,000 units per year; after that war, the rate soon doubled to reflect the building boom of the 1920s. Again for World War II, a prewar annual rate peaked at about 700,000 starts, followed by a wartime dip below 150,000, and then a postwar eruption that soon more than doubled the earlier peak and multiplied the rate at the dip by 10.

As for sluggish supplies of harvestable timber and its products in the short term, they are a function of various forces. One, sustained-yield policy has a short-period analogue called "evenflow," which is interpreted to constrain the allowable harvest, notably on public lands, and thus renders unresponsive a major source of raw material. Two, transportation facilities cannot be enlarged readily. Nor can processing facilities, especially since the passing of the era when a myriad little sawmills, previously stored away in barn lofts when prices softened, would be brought out again and put to work for better markets [6, p. 244].

The most recent real-price surge has been occurring during the past few years. The plateau reached after the steep rise that followed World War II endured for about two decades. There were short-term ups and downs, but as late as 1967, the deflated lumber-price index on the basis of 1947–49 = 100 was only about 103 [58]. It was in this era that the industry enjoyed many of the major technological improvements in its history and also divested itself of a great many small, relatively inefficient mills [21, pp. 15, 18]. Then in 1968–69, as though by way of warm-up, a notable price explosion took place, the deflated index rising more than 40 percent to a peak in the middle of the period and then falling off symmetrically. The year 1970 was tranquil. But the winter saw some ominous portents, and in 1971 the pressures erupted again and have continued to be active. There were some boxcar shortages and labor troubles and bad weather, but the big supply factor no doubt was the same short-term sluggishness that I have mentioned, and the tug upon prices came from the demand side. Housing starts [56], on a seasonally adjusted basis, were catapulted from little more than a million in January 1970, past 2 million in April 1971, to peaks of about 2½ million in January 1972 and again the following October and January. Between late 1970 and the high point in the spring of 1973, deflated lumber prices shot upward by more than 60 percent, and deflated prices of western coniferous plywood, which today are an equally important market index, nearly 90 percent.

Since then the movements have been irregular and at times dramatically downward. Perhaps a new plateau is taking shape for lumber.

Response to the Crises

The recent upheavals in wood-products prices have drawn nation-wide attention, not to these products alone, but to all forest resources and to the issue of their supply. This issue may be viewed as one of planning for the allocation of the national effort. The recent upheavals have called forth many a plan and proposal.

The Congress has held hearings on prices, production, and trade [47, 43, 39, 42, 41, 45, 44, 46]. It has considered legislation for intensifying timber management on the public forests, but such proposals have been attacked by conservation groups on environmental-protection grounds and have failed to pass [5, p. 163]. It has put curbs on our rising log exports to Japan, despite the counter-argument that such curbs will simply drive the Japanese importers to Canada, where they will buy timber products which could otherwise go to the United States [26, p. 19]. It has passed the Forest Incentives Act of 1973 to subsidize timber-growing on farms and other small forest tracts [38], despite wide skepticism about the effectiveness of such subsidy.

The White House has set up task forces and panels to make recommendations. It has given authority for increasing the national-forest harvests on an emergency basis [26, p. 15], but such increases have now been voided by conservation groups acting through the courts [27, p. 193; 13, pp. 228–229, 235–236]. It has instituted price controls which have appeared to affect prices very little, and sometimes not in the way intended [34, pp. 55–65]. It has heard from its Advisory Panel on Timber and the Environment [30] that except for lands designated once and for all as noncommercial, the federal forests should be managed intensively for wood and other services in an integrated program, that harvests from the western national forests should be substantially increased, that public timber supplies should be used to forestall price crises in disregard of the even-flow principle, that private forestry should be supported and encouraged, that disruptive log-buying by the Japanese should be controlled, and that plans should be drawn for effectuating and financing such measures.

At the same time, other agencies have been active in voicing their thoughts. The wood-products industry has released an intensive analysis of the 1970–73 events, underscoring the competitiveness of the industry and the disadvantages of public control [34]. The conservation groups have, in general, taken the position that the timber-supply problem has been exaggerated and that its solution lies in intensified private forestry, export controls, encouragement of substitutes, and so on, while the public forests should be dedicated to a greatly enlarged wilderness system and to management of the remainder with emphasis on aesthetic values [4, pp. 53–62; 37, chap. XVI; 41, pp. 50–89]. The Forest Service has released a comprehensive Outlook Report on the timber situation in the United States, pointing to the likelihood of serious shortages in the years ahead [49]. Academic and research groups have made studies and sponsored symposia [32, 11] at which the conflicting views have been aired and traced quite clearly to differences in basic values. The differences themselves can be seen in fundamentally different ways. Housing for the poor versus wilderness retreats for the wealthy is one way—environmental degradation versus enhancement another—wood versus its polluting, nonbiodegradable substitutes another—utilitarianism versus romanticism another.

Theory of Timber Characteristics

Behind our timber-supply events and controversies stand some traits of the commodity itself which help explain its supply behavior in theoretical terms. An influential trait is that standing timber is at one and the same time a wood-producing factory and the resulting product—i.e., wood. To harvest and use the wood product of a tree, one must demolish the tree: he cannot take the layers of new wood from the stem and leave the rest of the machine operating as he can when he takes apples from an orchard or steel from a plant which itself is made of steel.

The trait that factory is product is shared by many commodities—and, indeed, by all during the Marshallian market-supply stage. What especially characterizes timber is that it remains in this stage, which I prefer to term *stock* supply, during nearly all its production period. Some years ago, in a very conservative calculation for New York forestry, John Fedkiw [8, p. 105] estimated that at least three-fourths of all the current costs of an active management program arise solely from the holding of timber stocks. The rest is land costs, roading, forest protection, silviculture, and administration. There simply is not very much that one can reasonably do to make a forest grow faster except to pack in more tree capital. By this means, one can raise the total physical output of wood, but of course one encounters diminishing rates of return, both average and marginal, on this capital.

Clearly, the incentive to carry such capital does not stem from product price level (though it may come from expectations of change, but that is another matter): if prices change, the opportunity cost of carrying capital changes in equal proportion, and no rational supply response is possible. That is to say, the stock supply of timber, which is the dominant form of supply, has essentially no price elasticity [8, pp. 214–223].

Rather, the quantity of timber supplied—i.e., the quantity invested—is, like other investments, responsive primarily to the investing firm's guiding rate of return: the rate, however derived or implied, against which the firm may be considered to judge whether the *promised* rate of return is acceptable.

It is true that timber growth may be accelerated by such measures as planting, cultivation, fertilizing, drainage, irrigation, and so on, but few of these labor and nontimber capital inputs are economical at any price experienced to date. What I am saying is that the short-run supply of timber, like the stock supply, is inelastic to price.

In the long run, as in the short run, the price of timber has some influence as a supply variable where there are inputs of labor or of capital other than timber. For example, price could be supposed to have some weight in the long run through its effect on land use. But here an additional trait of timber becomes influential:

trees may take quite a long while to reach marketability. In forestry, even the short run may stretch out timewise. The market values to which managers look for their expectations and plans may be those of the far future; such prices have to be discounted over time. Again, the guiding rate of return steps in as the crucial supply variable.

Some Empirical Findings

A study has been made of the long-run supply of West-Coast Douglas-fir timber [50, p. 76]. The study is normative in that, although it is based on production functions taken from experience, these are interpreted under the assumption that the timber grower is a profit maximizer (loss minimizer). The results show price elasticities in the range 0.07 to 0.12 (i.e., approaching absolute inelasticity). Elasticities to the guiding rate of return are in the range minus 0.7 to minus 1.1: about ten times as great as price elasticities in absolute terms.

Some tentative results are available from a similarly normative study of spruce and balsam fir in the lower Saint Lawrence-Gaspé region of Quebec. In this study, Roger Miville-Deschênes [25] finds price elasticities of long-run supply which are essentially zero at all guiding rates of return down to about 6 percent. At rates below this, price commences to have some effect on output incentives, but even at a guiding rate of zero, an increase in price from $6 per cunit to $50 would promise to raise regional timber output only from about 4.2 million cunits to 4.7 million. The price elasticities in this interval run between approximately 0.02 and 0.12.

Miville-Deschênes' findings, if he verifies them, lead to interesting conclusions about the timber-supply problem in that region of Quebec. There, guiding rates of return tend to be high, while rates of financial return from timber growing tend to be low: typically a very small percent per annum. A social program to increase private timber output on a continuing basis might conceivably encounter trade-offs between subsidy to lower the rates of return which guide forest management and subsidy to raise timber values—i.e., to lend financial encouragement to use labor and nontimber capital as silvicultural inputs. These trade-offs might well be such that the best path along which to expand the program might be to work upon guiding rates first, and only if they were driven very low to give attention to timber price (Fig. 1). But in any case, society can beam

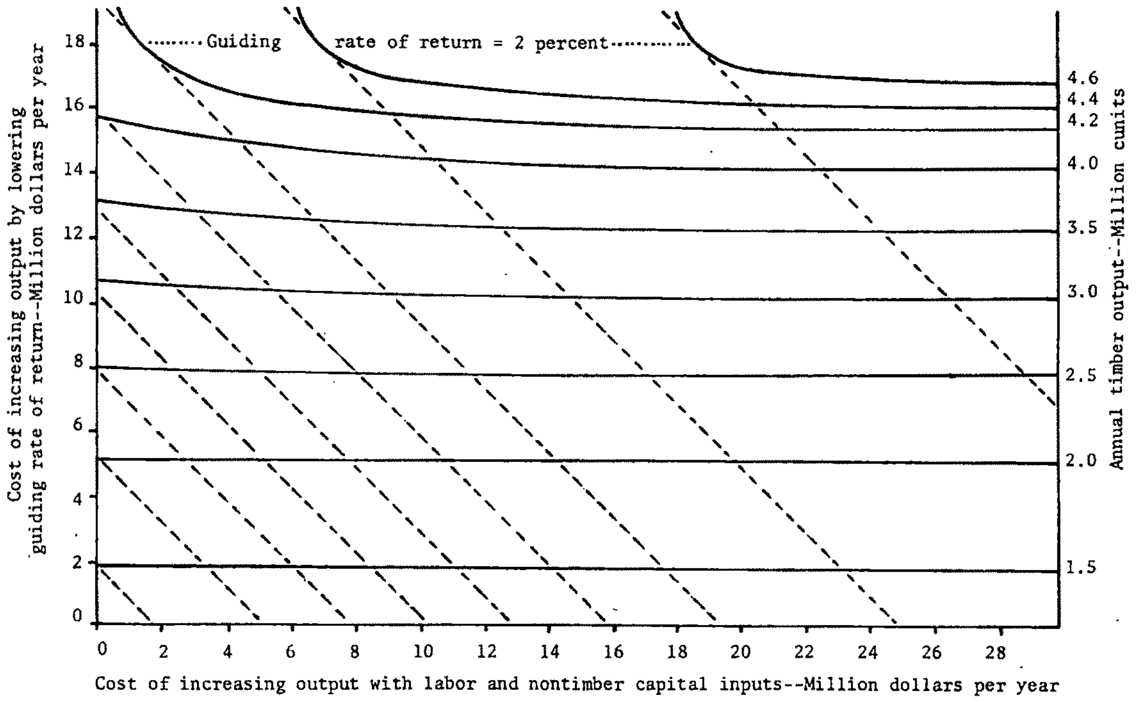

Figure 1.-- Tentative findings by Miville-Deschênes for social programs to increase timber production in the Lower Saint Lawrence-Gaspé region of Quebec. Solid lines represent iso-output (revenue); broken lines, iso-cost. The expansion path runs vertically upward from the origin to the $18-million cost level, thence horizontally to the right, along a line representing a 2-percent guiding rate of return.

price signals at forest owners until everyone concerned is blue in the face, and little will happen except an exchange of money from one set of pockets to another.

That is to say, all our vast consumer efforts over the decades to buy, bid, and wheedle more wood out of our timber factories by offering to pay higher and higher prices for wood and its products have served merely to keep the processing industries afloat and to leave the timber situation about as it would have been anyhow.

While price supply has its problems, so too does guiding-rate supply, at least in our current circumstances. Although net earnings of a small percent are far from representative of North American forestry, they are symptomatic of the problems of forest finance.

A 1958 study [33, p. 11] of net annual rates of return before taxes showed southern pine topping the list of eastern types of forest, at 7½ percent, and suggested that West Coast conifers may do about as well. On the other hand, our northern hardwood forests came out at about 2½ percent. These figures make no allowance for speculative gain from real-price increases or for speculative loss from real-cost increases. They represent the gross earning capacity which derives from the vigor with which our trees were—and are—endowed by nature.

Why Grow Timber?

Under such circumstances, why does anyone bother to grow trees for timber: why is there any timber supply at all, except what is left of our original forests?

Of course, many owners do not grow their forests for timber or hold them for timber. The public, which owns 30 percent of our 520 million acres of productive forest land in the United States, has set aside about an eighth of its holdings for parks and the like, not to be logged. Private owners other than wood-using firms—i.e, farmers, other rural residents, and small-scale absentee owners—hold 57 percent of the productive forest and reserve a portion of it, an unknown portion, for nontimber purposes such as scenery and protection. The reserved portion may be large.

As early as 1949 Solon Barraclough [1] estimated that the majority of small forest tracts in New England were held primarily not for timber production. A 1973 study by Hugh Canham [2] in New York suggested that nearly 30 percent of the privately owned forest was essentially unavailable to loggers. Such percentages vary with the region, with the times, and apparently with the investigator.

But what about the timber which *is* grown or held for harvest? How does one account for it?

The public timber is managed, in general, as is that on the national forests: "to furnish a continuous supply . . . for the use and necessities of the people of the United States" [16] under sustained-yield principles, as a safeguard against timber famine and for the other values of forests.

The private timber is managed for the widest possible range of purposes, such as financial security, speculation in land [29, pp. 16–18] as well as in the crop, and tree-growing for pleasure and possibly the hope of profit, too. Many a landowner finds himself possessed also of timber and "grows" it by default. Thirteen percent of all the productive forest is owned by the timber-processing industries as an integrated enterprise, subsidized by and providing raw-material insurance for the other enterprises.

The situation is summarized by John Segur, for years an executive and consultant in the forest industry. Referring generally to the financial status of forest lands in the United States, he says, "To my knowledge, there is presently no forest resource unit anywhere which exists as an independent, self-sufficient unit" [36, p. 32–7].

Nevertheless, timber forestry *is* practiced. It gets started in a region, typically in industrial and government holdings and programs, and then social momentum develops and there is a take-off, widely involving other lands. This has happened in the southern pine and in the Douglas-fir regions.

Socialism in Forestry

As one reviews the history and status of timber supply in our country and in the parent nations whose culture we share, he is not surprised to find a considerable degree of social involvement in forestry. Or perhaps he is surprised to find that the forestry sector of our economy is not more largely socialized.

Be this as it may, government in the United States owns more than half of the board-foot stock of timber growing on productive land not publicly reserved [49, pp. 244–247]. Government takes responsibility for managing this timber; it also markets the timber, not as logs at roadside, as is the practice in much of western Europe, but as standing trees designated for harvest. Government exercises control over the logging practices, but these are performed by private firms, as are all the subsequent transportation, manufacturing, and distribution.

In the privately owned forest lands of the United States, government takes a many-faceted interest. Federal regulation of private forest practices has been proposed from time to time and received especially lively attention in the 1930s, but none of the numerous bills was ever passed. On the other hand, a number of states have regulatory legislation with mandatory features such as requirements for forest regeneration and optional features such as access to timber management and marketing advice.

The federal government in 1943 instituted special income-tax procedures which are believed to have spurred the intensification of private timber management [40, pp. 2822–3027], and some of the states also have favorable tax laws [59]. By contrast, the traditional *ad valorem* property tax appears to militate against investments in timber capital [7, pp. 125–128].

The federal and state governments have joined in a number of efforts to augment the supply of timber from private lands and to increase the efficiency of wood-products manufacturing and marketing. These include the control of fires and insects, the sponsoring of regional and state research, and the maintenance of a system for giving technical advice and assistance to private firms. The efforts are patterned after those designed for agriculture. But some of the features of the agricultural programs, such as price reporting, price and production controls, aids directed to the worker and the domestic establishment, and the regulation of trade, are largely absent from the forestry programs.

Also analogous to the agricultural effort, and in some respects transcending it, is the federal socialist program of national planning for American forestry. Two of the first planning statements were an 1878–1880 "Report upon Forestry," by Franklin B. Hough [20], Forestry Agent in the Department of Agriculture, and a 1913 analysis by the Bureau of Corporations in the Department of Commerce and Labor [57].

Thereafter, the national planning function was taken over by the Forest Service in the Department of Agriculture. From this agency, we have a series of six documents [52, 48, 51, 53, 54, 49] at approximately 10-year intervals, the latest being the 1973 "Outlook Report" mentioned earlier. Generally each report, in its statistics and interpretative bulk, has been more gigantic than its predecessors. Each has dealt with "timber supply," which might more accurately have been termed "inventory" or "production," and each has emphasized the looming inadequacy of "supply" in view of prospectively soaring "demand," a term which has proved to be long on appeal but short in meaning [10].

Yet the gist of the argument has been perfectly clear, just as it was in the 1650s, at the close of the Thirty Years' War: there is going to be a timber famine unless we get busy and do something about the timber supply. But if one searches to find what the goals may be and what the alternatives are for reaching them, then the issue is no longer clear at all.

Conclusion: Research Opportunities

It is traditional among research people to close their discussion of a problem with a statement on the research required for resolving it. Let me sketch very briefly some ideas on research relating to timber supply. I see this as high-priority research which to date has been largely neglected and which could well be undertaken in university circles. Let me make just three suggestions.

First, it would be helpful to organize an ambitious research project aimed at developing a workable, usable planning procedure for forestry in the United States. The idea behind the research would be land-resource planning in general: the whole interrelated system which includes the various types of farming and forestry and other uses of land. An effort would be made to see forestry in the context of other uses and timber in the context of forest resources as a whole. An attempt would be made to view planning as the identification of alternative goals and courses of action—i.e., of alternative policies—and the estimation of consequences in each case: advantages and disadvantages, or revenues and costs in a very broad sense.

The purpose of the research would be to devise and test a procedure which could be followed and adapted by a team of resource people of widely representative talents to give policy makers a continuous flow of information helpful in their decisions.

Second, it seems essential, if we are to improve our timber planning materially, to learn a lot more about supply. In respect to private forest owners, and public owners too, we are greatly ignorant of the specifics of their supply responses. We have some normative analyses, as mentioned, but we have few fully empirical positive studies of the behavior of forest owners. To what kinds of change in circumstances do owners respond in their output of timber and other services of the forest? What are the interactions among the guiding rate of return and product price and total income and community custom and technical assistance and so on, in their effect upon owners' forestry behavior?

What are the efficient social devices for affecting the influential supply variables? For example, if it is indeed true that reducing a firm's guiding rate of return will provide a large incentive for the firm to intensify its forestry practice, then how effect such reduction? How costly is it, and thus how efficient? Is it to be accomplished through special credit or the social renting of growing stock, or how?

The foregoing are difficult questions, for so many of our forest owners have complex and shifting aims, and so many are handicapped by grossly imperfect understanding of forest resource values and technology.

One way of looking at such research is this: if high timber prices are unhelpful in increasing the quantity supplied, and if lower prices are not detrimental to the flow of timber, then the social interest may lie in finding nonprice devices for raising the supply, so that prices will be held down. William McKillop [24] estimates that American consumers would enjoy a net financial benefit of some $472 million per year if softwood timber output were increased 7 percent above its current level and prices accordingly were to shrink by 5 percent. Dwight Hair [18], looking at the matter more broadly, lists the advantages of timber-supply enlargement and price reduction as including not only lower consumer costs, but also manifold gains from the use of wood rather than substitutes, increased rural income and employment, an improved balance of international trade, and favorable influences on the environment.

The purpose of the research envisaged here is to broaden our understanding of program alternatives—so that, for example, the Congress can have more choices in its timber-supply efforts than simply to pass another subsidy bill such as the Forestry Incentives Act of 1973.

Third and last, I see tremendous opportunity in a large program of research aimed *indirectly* at the timber-supply problem. This would be a program to learn more about the consumer of wood products, and particularly about the technology of consumption of such products and their substitutes. Here forestry research workers can take inspiration from their colleagues in agriculture. Home economists were pioneers in the applied economics of consumption, and agricultural economists, too, made important early contributions of great practical value [3, pp. 355–371].

A few foresters have interested themselves in consumption technology. Carl Reidel [31, pp. 266–270] has pointed out that large quantities of wood can be saved in such activities as logging, sawmilling, paper production and recycling, and urban renewal. Lassen and Hair [22, pp. 404–407] have attempted to quantify the possibilities. But forestry economists, by and large, have failed to follow this fruitful path toward solving the problems addressed by their profession [23]. Their orientation has been almost exclusively toward the producer and away from the consumer. When a problem has arisen in respect to the timber supply, their response has been, "How can we increase the efficiency of production?" One seldom if ever hears the questions asked, "What can the *consumer* do? How can *his* technology be made more efficient?"

The purpose of the research proposed here is to explore the trade-offs between production and consumption technology and values in our forest-resource allocation problems. It is to open what may be a gold mine of opportunities for socially more beneficial forest use, ranging from residential construction to wilderness recreation.

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Session 3

FOREST ECONOMICS

Discussants: Neil Cook, U. S. Department of Agriculture, Economic Research Service, Little Rock, Arkansas; Lawrence S. Davis, Utah State University; J. Dean Jansma, University of Florida; Charles R. Miller and Thomas J. Mills, U.S. Department of Agriculture, Washington, D. C.

Session 4

FINANCING PUBLIC SERVICES IN RURAL AREAS

CHAIRMAN: FRED H. TYNER, MISSISSIPPI STATE UNIVERSITY

Public Service Delivery in Rural Areas: Problems and Decisions*

LONNIE L. JONES AND PAUL H. GESSAMAN

PUBLIC SERVICE QUALITY AND AVAILABILITY in rural areas of the United States remains low relative to urban areas [9, 20, 29]. Efforts to improve public service delivery in rural areas have resulted in only limited improvements in service availability and little or no reduction in service costs. Professional workers, elected officials, and voters find service delivery problems to be frustrating and not readily amenable to solution.

Research efforts have usually been discipline oriented, methodologically sound, and focused upon one or two aspects of service delivery. They have assumed constant or ignored the complex of related issues and interactions having important impacts on service delivery. These research results have usually had limited applicability. Prescriptions for modification or change of delivery systems have typically favored consolidation of functions and/or service delivery units, but have been unsuccessful in predicting the social and economic consequences of consolidation. Both the issues needing examination and the approaches to research on these issues are poorly defined. No overall conceptual framework for research on public service delivery has been identified, and in the absence of such a framework, research efforts remain fragmented and disjointed. Under these conditions it was with more than a little reservation that we approached the preparation of this paper. We recognized that we had neither the conceptual framework nor the knowledge base necessary for a complete and consistent treatment of service delivery problems. Despite these deficiencies we hope to stimulate thought and discussion on issues related to the delivery of public services in rural areas.

In this paper we assume that achieving consumer satisfaction is the logical and legitimate goal of public service delivery. In light of this assumption we examine some aspects of public service delivery in rural areas and identify certain technical and decision problems in planning and managing service delivery systems. The paper deals with four aspects of service delivery in the rural setting: (1) the nature of community services, (2) some characteristics of service delivery systems as related to consumer satisfaction with service delivery, (3) the context within which decisions on service delivery are made at the local community level, and (4) some information needs of decision makers responsible for planning and managing rural service systems. We conclude with a brief discussion of the potential for extension and research efforts by agricultural economists.

The Nature of Rural Community Services

A sizable body of literature examining the nature of public goods and services has accumulated in recent years.[1] These writers have described pure public goods as being produced collectively; jointly supplied, as they are available to all prospective users if they are available to anyone; and not divisible into discrete "packageable" units amenable to purchase and sale in the market place. These attributes of public goods are opposite to those of pure private goods, which are characterized by being privately pro-

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[1] This literature is too extensive to cite fully. The interested reader may wish to consult [4, 8, 18, 21, 24, 25, 26, 28] and items listed in the extensive bibliographies of [8, 21, 28].

duced; privately consumed; and divisible into discrete units purchased and sold in the marketplace. As is obvious from these brief definitions, there are few pure public or pure private goods.

Rural community services possess a mixture of the attributes associated with pure public and pure private goods. The market is not an effective mechanism for indicating needs or allocating products or services possessing this mixture of attributes. In the absence of effective market mechanisms, various levels of government have carried out supply and market intervention activities designed to insure the availability of community services when and where a need has been expressed. Units of local government have been the principal providers, but have been hampered by limited ability to bear the associated costs—especially where population density is low and service delivery is costly or difficult.

Rural community services are inseparable from the service delivery systems by which they are made available to users. Delivery systems may be capital intensive (sewer and water systems, transportation systems) or labor intensive (education, medical care, police protection), or intermediate between these extremes. Both public and private providers may be involved.[2] Consumers utilize these services directly, and indirectly through consumption of private sector goods and services containing a community services input component.

Community services as provided in most rural communities have exhibited most or all of these characteristics: (1) the services are thought necessary for the public good, (2) they are available to and utilized by the general public, (3) they are generally provided through relatively rigid institutional arrangements by the public sector or regulated private monopolies with high fixed investment, (4) prices of services (fees) are not set in the market and some services are provided at zero marginal cost to the consumer, (5) prices (fees) often do not allow recovery of fixed costs and may not cover variable costs, and (6) total cost to the consumer may be constant per unit of time and independent of the quantity consumed [11].

The Nature of Public Service Delivery Systems

In our view, a desirable delivery system is one that provides a given service at a cost, time, place, and in a form acceptable and satisfying to consumers. This implies more than the simple availability of the service providing agency or facility within the rural area or community. In the operational or functional sense, the services must be both acceptable and accessible to potential users.

Since services vary from highly labor intensive to highly capital intensive, the appropriate delivery system will undoubtedly depend upon the service being delivered. Moreover, desirable delivery structures may be expected to vary among rural communities. Preferences and socioeconomic characteristics of the client population in interaction with the total environment determine locational differences in consumer expectations and desires. A delivery system that is outstanding in one community may be totally inadequate if transplanted to another location.

Agricultural economists have largely ignored these considerations in their research on rural community service delivery. Research efforts have concentrated almost exclusively on the direct operating cost of the providing agency, with little attention given to the organizational or institutional arrangements that will best meet client needs. Existing organizations, or any new organizations suggested for service delivery, are implicitly assumed to be appropriate and adequate to satisfy consumers. Possibly it is believed that the type of institution has no influence on delivery system performance. This approach has usually resulted in prescriptions for consolidation of many small delivery systems into fewer and larger systems serving wider areas. It has been argued on an efficiency basis that consolidation will nearly always make the rural resident better off and almost never make him worse off. But prescriptions for consolidation of rural service systems can be questioned on at least two important points: short-run cost savings may not exist following consolidation in areas where population densities are low; and the institutional changes required for consolidation may reduce consumer satisfaction.

Cost studies of service delivery

The number of economic analyses of service delivery cost reductions achieved through local government consolidation, multi-community cooperation, creation of regional authorities, and school district consolidation has increased in recent years. Findings do not support consolidation as a universal means of reducing costs of services in rural areas of low population density. Factors other than size of service delivery system are usually found to be equally important in determining per unit costs. These factors may be unique to the area or service being examined.

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[2] Private providers are often closely regulated.

Daugherty and Jansma found that unit water costs were reduced more by higher average water use per customer (intensity of utilization) than by the number of customers served [7]. Schreiner *et al.* [27] found that the disposal phase of solid waste management systems (utilizing landfills) showed significant economies of size, but reductions in per unit cost of collection were more closely related to density of customers served than to numbers of customers. Consolidation of collection to serve a larger population did not reduce costs.

In a study of costs for rural fire protection, Hitzhusen found that size economies were realized in systems serving populations up to about 5000 persons. Beyond this community size, costs per capita showed virtually no change [15]. Similar results were found from a survey of solid waste management costs for rural Texas communities [12].

White and Tweeten estimated total costs per ADA by school district size in Oklahoma [31]. For a student density of 1.8 transported students per square mile, a cost minimum was reached at 675 ADA. However, there was little change in cost between 400 and 1,100 ADA as increases in transportation costs offset savings in operational costs of the school plant. Differences in student densities caused significant differences in the least cost school district size and average cost.

Eddleman's study of hospital costs in Florida revealed some cost savings from consolidation within his study area. But definite limits were found on the extent of feasible consolidation because of "sizable external costs of patient travel as well as diseconomics to size in the production of health services beyond a certain hospital size" [10].

These and other studies of the feasibility of reducing costs by consolidating small delivery systems into fewer larger systems reveal similar cost-size relationships. Economies of size are found for some services, but they are usually exhausted within relatively small size systems. Increases in public or private transportation costs offset savings in operating costs of the delivery unit. Costs associated with low population densities, typical of rural areas, seem to override short-run benefits from consolidation of service systems.

The length of planning horizon is of critical importance in the planning of service delivery. In the short run, the period of time within which the existing pattern of residence is fixed, reductions in total costs per unit of service may be quite limited and difficult to achieve by consolidation or creation of area-wide delivery systems. Potential cost savings do not appear sufficient to stimulate voluntary exchange of locally controlled and operated smaller systems for larger and less accessible consolidated systems. Hence, we cannot consider consolidation to be a universal solution for short-run problems of rural service delivery.

In the longer run, patterns of residence and population density are subject to change through migration and the natural growth or decline of communities. To the extent that growth centers emerge, and a substantial proportion of the rural population is concentrated in areas of relatively high population density, it may be possible to reduce system costs by concentrating public services in these areas. If this occurs, persons outside the growth centers probably will experience increased private costs of service utilization. Tefertiller [29] supports this as a policy for reducing service costs and inducing business investments in the growth centers. However, it is a long-run solution that begs the short-run service supply problem faced by sparsely populated areas and widely dispersed communities.

Organizational form and service delivery

A significant and growing share of services in rural areas is provided by units of general purpose government and quasi governmental bodies such as housing and transportation authorities, community planning agencies, water districts, and other public agencies.

The influence of organizational form upon effectiveness is receiving attention by scholars in "public economics" disciplines. Serious questions are raised with conventional assumptions about the more efficient delivery of services through the creation of fewer and larger public or private bureaucracies [22, 23, 30, pp. 112–123]. This research indicates that structural changes inherent to consolidation of units give rise to changes in the conduct and performance of organizations. These changes may be sufficient to negate benefits from the utilization of improved technology and the elimination of duplicating functions, hence preventing the attainment of improved service delivery at lower cost. Consequently, consumer satisfaction with service delivery may not be improved, and costs may be as high or higher than before consolidation.

Two questions are basic to the institutional issue: What are efficiency implications of alternative organizational forms for service delivery? And what are the implications of alternative organizational forms for consumer satisfaction with service delivery?

The most common organizational form for public service delivery is the public bureau. Niskanen [22] develops a conceptual framework for examining the behavior of public bureaus viewed as providing a total output of services for a total budget. Hence, the public bureau can generally be viewed as a non-profit monopolist operating under a cost reward system different from that familiar to privately owned profit-making firms.[3] Niskanen suggests that a major problem with the supply of public services through bureaus is *allocative inefficiency* rather than *technical inefficiency*. Since the bureau faces an "all-or-nothing" demand curve and since it cannot appropriate excess profits, its rate of output is such that marginal outputs will be valued less highly than alternative outputs which could have been produced from the marginal inputs.

The bureau is motivated to maximize its output for a given budget and to maximize its total budget. The bureaucrat can benefit only indirectly from the operation of the bureau, thus he seeks to maximize a utility function that may include as variables: salary, perquisites of the office, power, reputation, and ease of managing the bureau. These variables are budget elastic, increasing as the bureau's budget increases. The bureaucrat will attempt to expand output and the budget so long as his total budget covers total costs. Hence, the public bureau is allocatively inefficient in a manner converse to that of the profit maximizing monopolist. Niskanen concludes that the service providing bureau is an inefficient provider of the level and quality of service demanded by consumers. Even though "demand by consumers may be the basis for establishing a bureau, the interest of this group in preserving the bureau will diminish or disappear as the bureau creates no consumer surplus, except by negligence. A bureau, however, creates a substantially larger factor surplus than would a competitive industry, and the primary interests in continuing the bureau are likely to originate from the bureau itself and the owners of specific factors" [22].[4]

This problem is further compounded by the non-transferability of ownership rights in the public service delivery bureaus. The public bureau is owned by the citizens it serves, but individuals can neither sell ownership shares nor purchase shares from other owners. Ownership is automatic by virtue of residence and can be relinquished or traded only by movement to a different location and political jurisdiction [30, p. 117]. The public bureau lacks incentives to produce output with the least cost combination of resources, to seek the most effective means of delivery, and to respond to consumer demands. Consequently, the typical public bureau that was established to satisfy consumers' service needs evolves into an agency with internal (or agency) orientation and limited effectiveness in meeting consumers' expectations of service delivery.

It is unlikely that this type of *agency oriented* system will formulate service delivery objectives and procedures consistent with those desired by local service users, especially as the service area becomes large and social contacts between consumers and agency personnel are reduced. Agency procedures will tend toward service delivery at a point most convenient to the agency in an effort to minimize agency costs, but not its budget. The agency oriented system is likely to take little or no account of consumer costs and may take little cognizance of individual consumer needs or demands. It tends to provide and deliver services as a part of agency programs without regard to the appropriateness of these services. This occurs because it is easier to operate a program oriented agency than a problem oriented one. As the agency increases in size and complexity through consolidation or growth, these characteristics associated with internal and independent agency objectives may be expected to intensify rather than diminish, and the agency orientation increases at the expense of consumer interests.

Since the writings of Woodrow Wilson, we have generally assumed that the hierarchically ordered bureaucratic system is the most efficient organization for public service delivery [32]. Efficiency usually has been defined in terms of minimizing agency cost and duplication of functions. But producer efficiency in the absence of consumer satisfaction with the service has no meaning. Can we continue to rely upon the numerous federal-state-local bureaus that exist (and are being created) for the purpose of delivering public services in rural areas? If our ultimate goal is consumer satisfaction in the delivery of community services, it appears we cannot assume that the traditional bureaucratic organizational form is necessarily desirable for the delivery of all services. Neither can we assume that our efficiency studies will lead to lower costs to consumers unless the providing organization has the incentive to adopt cost-saving innovations.

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[3] While Niskanen limits his analysis to the public bureau, many parts of it appear to be applicable to any bureaucratic organization.

[4] The argument that bureaus are inefficient is not new. [Marshall 19, p. 284] gives reasons for bureaucratic inefficiency in private firms due largely to friction of operation. However, these recent analyses more nearly develop a conceptual framework for bureaucratic inefficiency due to conduct, performance, and non-transferability of ownership leading to output decisions inconsistent with consumer interests.

Very little attention has been given to the impact of alternative organizational forms upon consumer satisfaction with rural community services. Economists and political scientists concerned with service delivery in the urban setting have devoted considerable effort to examination of this issue [4, 23]. Alternative organizational forms, including direct service provision by private firms, contractual arrangements between governments, contracts between governments and private firms, increased reliance on user fees, and other institutional changes have been suggested. Further, alternatives for changing the incentive and reward systems of existing organizations (e.g., introduction of competition and/or market mechanisms) to improve consistency between agency and consumer goals have been examined. Similar analyses are needed in rural areas to identify and evaluate the range of organizational alternatives that may be desirable for public service delivery.

Obviously, all alternative organizational forms have been neither identified nor analyzed. We are constrained in this paper merely to offering this as a fruitful area of research that has been largely ignored in the past. It may be that the final solution will consist of a combination of existing institutions that insure some measure of uniformity of opportunity among areas and flexibility to meet more nearly the consumer preferences in local areas. Local freedom of choice has historically received high social priority. It would seem appropriate to attempt to preserve these attributes as we plan systems for rural public service delivery.

Regardless of the organizational form, it appears the desirable delivery system would be one with a strong *client orientation* in which service delivery is evaluated at the point of consumption rather than emanation [6]. A client oriented system would focus upon the problems of consumers rather than upon agency programs. Within resource constraints, user satisfaction would be its primary goal. This implies a system with continuing flexibility to respond to individual demands and unique local situations. Such a system would probably require substantial consumer input to the design and implementation of agency effort. The need for this type system is clearly greater for the delivery of labor intensive services involving frequent person to person contact (such as education, welfare, health, and police services) than for capital intensive services.

Decisions on Rural Community Services

As units of local government have become increasingly involved in the provision of community services, they have looked to state and federal government for financial and technical assistance. In most cases this assistance has been conditional upon local entities conforming with guidelines, minimum standards, and application procedures set outside the local area. These requirements have usually been designed to prevent waste or loss of funds, to insure that all citizens will receive equal treatment, or to facilitate concentration of assistance in areas of special need.

Ample evidence is available that indicates these objectives have not been fulfilled. Rural areas receive only a small proportion of federal assistance despite their demonstrably lower levels of services. However, we do not wish to examine or debate these aspects of assistance programs. For the moment we are more concerned with the impacts of these requirements upon local decision making. To do this, we start by briefly examining the context within which local governments operate and then turn to a more detailed examination of some impacts upon local decision making resulting from requirements set outside the community.

Within the framework provided by federal and state constitutions, executive officers and legislative bodies at all levels of government seek to respond to the perceived needs of citizens. Where constitutional rights or legislative intent are unclear, in doubt, or challenged, court decisions provide interpretations and the legal basis for a variety of actions including enforcement. The intent of executive orders, legislation, or court decisions usually is implemented through the actions of federal and state agencies or through the creation of special purpose units of government such as housing authorities or special districts. Agencies typically develop and implement guidelines, rules, and regulations for the conduct of their activities, and these are uniformly applied across all locations and types of local conditions.

These characteristics of governmental structure and operation through bureaucratic agencies have resulted in restrictions upon the range of choice open to local decision makers. The combination of direct regulation, requirements for funding assistance, and the setting of minimum service levels has, in many instances, made difficult or impossible the development of local service delivery strategies that are consistent with local expectations.

Local human, financial, and physical resource limitations may restrict the set of locally feasible responses to community service needs so that there is little or no correspondence with the set of responses required to meet outside-the-community requirements and guidelines. When this happens, the decision maker is forced into a choice between locally feasible but legally deficient services and locally infeasible services meeting standards set outside the local area. In either case local people feel their return from tax dollars spent is unacceptably low, and decision makers react negatively to proposals for change. The resulting inaction, neglect, denial of need, and failure to respond to requests for assistance cripples many rural community service delivery systems.

Enactment of the Rural Development Act of 1972 has not significantly altered this situation. A substantial expenditure of local effort is necessary to secure assistance under the titles presently funded. The major funding authorities came from existing programs with all their attendant red tape and bureaucratic procedures. General revenue sharing appears to have greater potential as a source of funding for locally desired and locally acceptable services. However, a recent report shows less than 50 percent of general revenue sharing funds have been expended [5]. Uncertainties over allowable uses for these funds and fears that revenue sharing may be discontinued appear to be factors contributing to this situation. Some local decision makers have chosen to place revenue sharing funds in interest bearing deposits instead of expending them on service delivery systems whose continuation would be demanded regardless of whether or not revenue sharing is terminated.

The impact on local consumer satisfaction on non-local requirements and restrictions may be demonstrated in a variety of ways. In the appendix to this paper we show, by use of a community indifference map, the effects of three alternative funding arrangements. Recent research illustrates similar effects. For example, Bish and Ostrom summarize research indicating increased consumer satisfaction and lower costs with police services where greater latitude for local decision making was attained through decentralization [2, pp. 43–46]. Bawden cites numerous examples of inefficiencies and inequities resulting from "in kind" poverty programs and from the linking together of assistance programs (e.g., Medicaid and public assistance) [1]. Thus, there appear to be both conceptual and empirically observed reasons for preserving a range of choice open to local decision makers.

Despite apparently valid reasons for seriously reconsidering both the customary organizational forms for service delivery and restrictions placed on local decision makers, we continue and expand our previous methods of stimulating improved rural community services. Reasons for this apparent illogic include: (1) the conventional wisdom, and the realities of funding and political influence, favor agency oriented approaches to problem solving; (2) as a country we are urban oriented and have chosen to ignore the realities of human and physical resource limitations faced by rural decision makers; (3) programs have been and are oriented toward urban dominated national goals and standards with little recognition that these may differ from rural goals and standards; and (4) given this national orientation, it is thought to be less expensive to entice the local community into providing the desired level of services through assistance programs tied to restrictions on local decision makers' range of choice.

Changes resulting in increased latitude for local decision making would substantially alter assistance programs. But, such changes appear to be necessary conditions for consumer satisfaction with service delivery in rural areas.

Information Needs for Local Decisions

Decisions on service delivery in most rural communities result in incremental changes. The level of services provided in the community is increased or decreased by small changes from the amounts provided in previous years. However, rising expectations of rural residents combined with the availability of categorical aid programs have resulted in generally increased demand for public services. As local decision makers consider alternative methods of meeting these increased demands, they need planning and management information adequate for decision making on service delivery.

The paucity of helpful information for this purpose is noteworthy. Until recently, the rural decision maker received little, if any, planning and management assistance. Land grant universities, the U. S. Department of Agriculture and other rural oriented organizations have recently accepted the responsibility for providing such assistance. But, the breadth and scope of informational needs presently are not well defined. There are at least three major considerations that must be dealt with if rural community services are to be provided in an efficient manner. These are an analysis of supply and demand for services; projection of factors influencing supply and demand; and institutional planning to evaluate alternative organizational forms for service delivery. Conceptual and measurement problems are associated with each of these as are opportunities for contributions by agricultural economists.

The supply of public services

The delivery of each rural public service is a resource-using activity. The basic management problem of the local community is that of efficiently allocating its resources to produce desired levels of public service output and quality. Theoretically, this management problem differs little from that of the private firm, but there are numerous methodological and measurement problems involved in estimating production and cost functions. The measurement of output and quality has been discussed most frequently as a major problem [9, 13, 14, 16]. Other complications include the identification of relevant costs and the estimation of optimal size of delivery system.

Economists can contribute analyses of production and cost relationships of individual services and interrelationships among services insofar as these items of information can be compiled. However, we must recognize that such concepts as economies of size or least-cost size of unit that have guided much of our analyses of private firms may be less useful in decision making on the delivery of rural community services. Local residents and officials are likely to be chiefly concerned with the total cost, quality, and accessibility of services. Reliable information on required inputs, expected outputs, and the most suitable organizational arrangements will greatly improve actions of decision makers.

Estimating demand for services

Serious limitations make difficult the estimation of public service demand through the transfer of concepts and tools used in estimating demand functions for private goods and services. Margolis states the problem as follows:

> No matter how difficult it is to estimate demand functions for private goods, we usually have observations of amounts purchased during several periods at a reasonably well defined set of prices. Often these gross observations can be supplemented with information about the attributes of purchasers—for example, their income race, residence, occupation, etc. But how different it is in the public sector. The consumers of the goods are not the purchasers; the purchasers are a mix of elected and appointed officials who pay with tax revenues; the taxpayers may not be the users of the services and decision makers may be neither taxpayers nor users. . . . Not only are there several steps between consumers and payers, but often the consumer may not be part of the political constituency which is doing the paying. [17]

The aggregate data series of prices and outputs so useful in analyses of demand for private goods do not exist for most public services. Few reliable measures of service output and price are available. Under these conditions, extensive surveys are required to determine who uses specific services and what are factors determining the intensity of use.

Estimation of service demand for a community or area may require a variety of analytical approaches. For those goods and services with relatively strong price signals (e.g., water, electricity, refuse collection) the individual preference and market behavior approach may be employed. Such services are usually financed through user charges. For other services where consumer preference signals are weak, we may find political approaches such as voting behavior of consumers, legislators, or office seekers to be useful [4].

Projection of economic factors

Local decision makers' willingness to supply community services and the willingness of taxpayers to support service delivery will depend in part upon their perceptions of future conditions. Projections of local conditions, including estimates of the expected level of economic activity and employment, the number and age distribution of the population, and the incidence and amount of taxation are vital to the decision making process. Estimates of the impact of major investments or disinvestments can provide the basis for estimating service needs in localities undergoing rapid change.

These types of information can be generated from regional economic analyses familiar to agricultural economists. Inter-sector relationships and secondary and tertiary impacts must be incorporated to provide adequate estimates. Reasonable approximations can be secured from the assiduous use of existing techniques. This process will become more effective when truly dynamic regional models are developed.

Institutional planning for rural services

Public services in rural communities can be provided through a variety of organizational arrangements. As indicated earlier, there is increasing evidence that the efficiency and effectiveness of service delivery may vary widely depending upon the organization of the supplying firm or agency. This evidence seems to justify more investigations to identify alternatives to the traditional bureaucratic public agency.

Agricultural economists can provide local decision makers with valuable information such as comparative analyses of public and private hospitals, public and private police protection, fire protection, garbage disposal, and other services. Research such as that conducted by Bryant [3] on poverty programs should be extended to other services and agencies. Those who desire to become involved in efforts of this kind will find work by political scientists, political economists, and (to some extent) rural sociologists to be of interest. A revitalization of institutional economics may also be in order.

We cannot resolve the questions relating to the appropriate organizational form for the delivery of rural community services, and universal prescriptions for appropriate organizational forms may never be forthcoming. However, we conclude that the local officials' ability to supply rural community services satisfactory to consumers depends upon both the characteristics of the service provided and the organization by which it is supplied.

Extension and Research Efforts by Agricultural Economists

A County Commissioner recently remarked to one of the authors that business at every Board meeting during the past year had included at least one request for total funding or matching funds for some type of services. Requests came from the local committee on aging, the local council of governments, the regional planning commission, a group working with youth, a group working with minorities, the county law enforcement council, the civil defense coordinator, and from others too numerous to mention. The Board fully funded some of these requests, partially funded others, deferred some, and refused some. Of greatest importance for the purposes of our discussion today was the County Commissioner's statement that in no case did the Board have objective and reasonably complete information upon which to make their decisions.

In many instances they did not know whether people in the county really wanted the services. The Board usually had only a hazy idea of the type and amount of services that would be made available in return for the money requested. And they had no way to evaluate the efficacy, efficiency, or appropriateness of the proposed delivery system.

This situation is not unique to one county. It is widespread throughout the counties of the United States and is shared with many or most of the legislative bodies of the nation's municipalities. Research to provide the needed information and extension programs to disseminate that information to local decision makers have a waiting audience.

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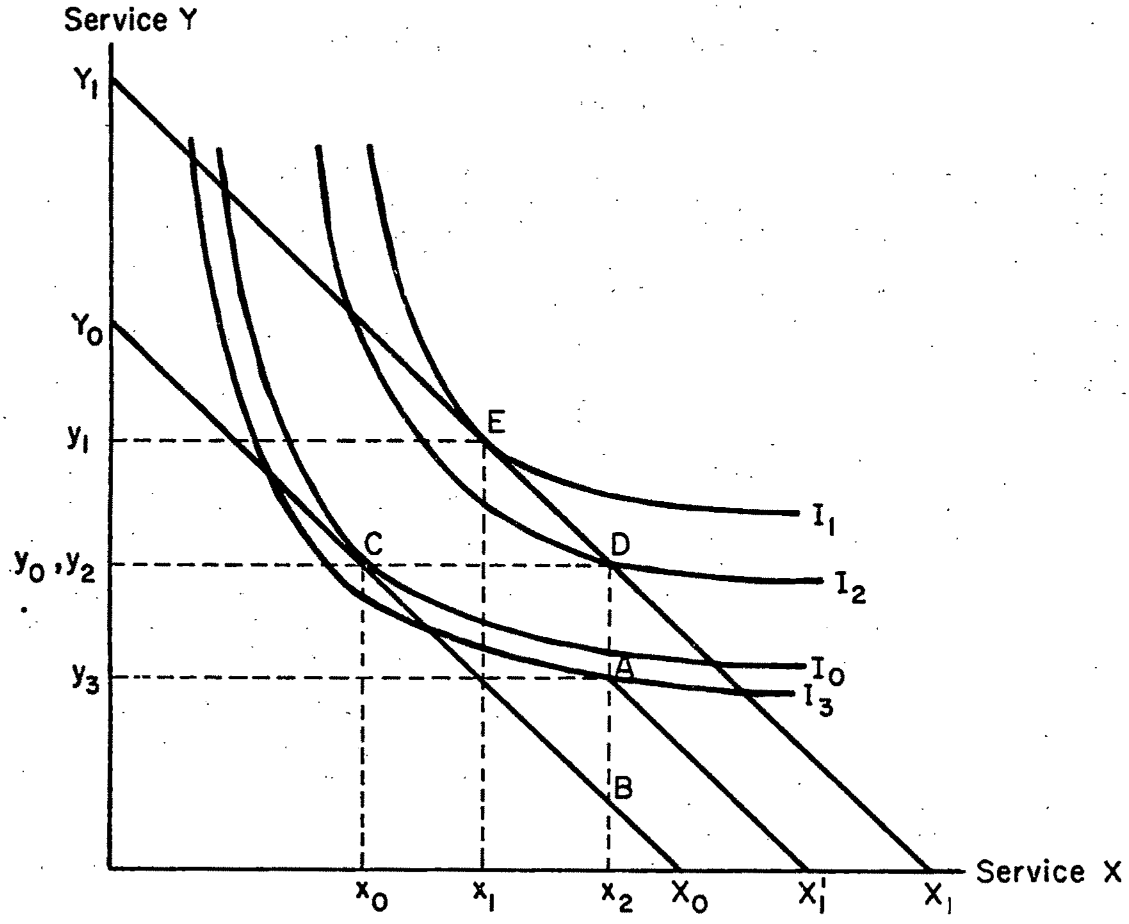

Figure 1

APPENDIX

Various impacts of financing assistance requirements and minimum standards are demonstrated using assumed community indifference curves in Figure 1. Service X is the service being examined, and Service Y is defined as a composite of all other services offered within the community. The community is initially at rest at point C, with x_0 of X and y_0 of Y provided. The following changes are considered:

1. An unrestricted lump sum grant would shift the budget line from X_0Y_0 to X_1Y_1 with a resulting shift x_0 to x_1 and y_0 to y_1 in the amount or quality supplied of services X and Y. Following the grant, community indifference level I_1 is attained where I_1 is greater than I_0.
2. A restricted grant in the same amount that must be expended on X giving a level of X greater than x_1, say x_2, results in attainment of indifference level I_2 where I_1 is greater than I_2 is greater than I_0. The level of Y remains at y_0 if the restricted grant is sufficient to support x_2 of X.
3. If the grant is for partial funding, requiring local matching funds and a minimum X of x_2, the allowable set of choices is severely reduced. If the grant is sufficient to allow the shifting of the budget line to X'_1 A B Y_0, decision makers must choose between providing services at point A where x_2 of X and y_3 of Y can be supplied (resulting in attainment of indifference level I_3 where I_3 is less than I_0) or points along the line B Y_0 which includes point C. Rational choice results in rejection of the partial grant and a decision in favor of point C.

Local Funding of Rural Public Services

WILBUR R. MAKI

RURAL PUBLIC SERVICES are viewed here as the local governmental functions performed in areas of submetropolitan status. Water supply and wastewater treatment, hospitals and health care, libraries and education, public housing, police and fire protection, refuse collection, and road maintenance are included among these services.

Local funding sources include primarily real estate taxes, service charges, and debt financing. Use of a local sales tax and a local income tax is authorized in several states. In almost all states, local governments derive small amounts of income from fees for licensing business, making inspections, new construction permits and miscellaneous functions.

Some rural services are provided most efficiently at the area level—for example, wastewater treatment—and are financed from area sources. Other services, like public education, are of local scale in their provision but of area or state scale in financing. A major concern here is the identification of those services which are best provided and financed locally and those which are not.

Scale, scope, and proximity considerations are involved in identifying an appropriate level of governmental organization for providing a public service. For example, improved efficiency is achieved by consolidation of small units into larger ones or by cooperation and coordination among several governmental units. Alternatively, purchases of services from private vendors or from other governmental units may offer an efficient alternative to the direct delivery of these services by a governmental agency.

Trade-offs occur between management efficiency and improved access to a public service in a geographically decentralized service delivery system. Consumer access is a function of spatial proximity as well as income levels [6, p. 333].

Finally, an expanded local resource base for public services is sought with growth-inducing public outlays. An important issue is the portion of total governmental resources which is set aside for basic economic growth as contrasted to those resources used simply to maintain existing public services and provide for the needs of an existing population. Benefit spillover and income redistribution considerations are of primary importance in identifying appropriate funding sources for these services [8, p. 23].

Rural Public Services

A primary concern of this paper is the effective organization of public service delivery in rural areas in terms of the community resource base and fiscal capabilities. Data for a multi-county area in Minnesota are used to illustrate the area economic dimensions of public service delivery [9]. A set of area economic accounts has been prepared which includes output and income estimates for an aggregate of public service sectors (Table 1).[1] Only the public industry sectors are presented; these include all municipal service enterprises (i.e., water and sewer systems, electric power systems, hospitals, and liquor stores) and all tax-supported services (highway and road design and maintenance, public safety, garbage collection and disposal, health, education, welfare, libraries, recreation, and general government).

A major contention of this paper is that rural public services can be viewed realistically for policy and planning purposes only in the context of the total economy of an area. The area economic accounts are extended, therefore, to include the local institutional linkages in the financing of public services (Table 2; see also [15, pp. 9–16]).

Producing public services

The gross output of public industry (Class 2) sectors was equivalent to about 28 percent of total household consumption in the given rural area. Public education and public administration accounted for 82 percent of public industry output. These two sectors include most of the tax-supported services.

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[1] Detailed data for the 23 private industry sectors are available in [11, pp. 36–54]. Public industry sectors are treated exactly like the private industry sectors with reference to input purchases. However, public industry outputs are allocated to purchasing sectors in proportion to service charges; the remaining outputs not covered by service charges are allocated to the public sectors which support these services.

Table 1. Estimated income payments of public industry (Class 2), household consumption (Class 3), and public finance (Class 4) sectors to specified income-receiving sectors, West Minnesota, 1967[a]

		Class 2						Class 3	Class 4			
Income receiving sectors		Construction 24	Utilities 25	Other retail trade 26	Health 27	Education 28	Public administration 29	Household consumption 30	Sales tax 31	Property tax 32	Assessments 33	Other taxes 34
								($1,000)				
Private industry	1–23	1,874	1,088	453	1,119	9,052	4,214	116,098	0	0	0	0
Public industry	24–29	12	125	4	15	313	146	6,491	0	0	0	0
Sales taxes	31	4	3	1	5	2	1	12,711	0	0	0	0
Property taxes	32	0	0	0	0	0	0	21,010	0	0	0	0
Assessments	33	19	17	4	23	127	60	492	0	0	0	0
Other taxes	34	31	25	7	40	49	23	8,316	0	0	0	0
Household	36	2,419	1,267	782	4,501	34,299	15,970	0	0	0	0	0
County	37	0	0	0	0	0	0	0	0	11,274	169	24
Municipal	38	0	0	0	0	0	0	0	0	3,277	1,147	2,224
Township	39	0	0	0	0	0	0	0	0	1,590	0	0
School district	40	0	0	0	0	0	0	0	0	15,898	0	1,037
Spec. distr.	41	0	0	0	0	0	0	0	0	0	35	1
State	42	0	0	0	0	0	0	0	13,676	2,502	0	6,554
Federal	43	0	0	0	0	0	0	0	7,523	0	0	5,469
Public industry	46	370	654	159	1,041	150	71	0	0	0	0	0
Household consump.	47	0	0	0	0	0	0	36,000	0	0	0	0
Institutional	48	0	0	0	0	0	0	20,000	0	0	0	0
Ecologic	49	0	0	0	0	0	0	0	0	0	0	0
ROW	50	1,881	671	260	1,718	7,121	3,315	119,329	0	0	0	0
Subtotal	30–50	4,723	2,637	1,213	7,326	41,751	19,440	217,858	21,199	34,540	1,351	15,309
Totals	1–50	6,609	3,850	1,670	8,460	51,116	23,800	340,447	21,199	34,540	1,351	15,309

[a] Income payments of the public industry (Class 2) sectors to the public finance accounts are less, per $1 of total outlay, than corresponding industry sectors; the difference is absorbed in the ROW sector (Row 50). Capital outlays of the household (Class 3) sector are included under the capital (Class 8) sector except the allocation for depreciation (Row 47) and interest (Row 48) payments. An additional $606,000 income payment (to public education) is included in the Sector 30 allocation for the public industry accounts (with the new total being $6,491,000 rather than $5,885,000 total in the earlier input-output tables).

Major current input requirements of the public industry sectors were local labor (62 percent of total) and local goods and services (20 percent of total). Interindustry purchases of capital inputs (by Class 7 sectors) were equivalent to 20 percent of current output. Total capital outlays—largely in education and municipal service enterprises—equaled 35 percent of total current outlays (Table 3).

Scale economies occur in the utilities sector—particularly wastewater treatment—and hospitals and health services. Political proximity to these services is not essential (except for primary health care units). Hence, some early candidates for consolidation are the two municipal service enterprises—wastewater treatment plants and hospitals. In addition, planning services could be provided more efficiently on an area rather than local scale.

An important distinction occurs in the production of a specialized service and its distribution among users. While wastewater treatment plants are early candidates for areawide management, the sewer distribution network may remain an individual municipal responsibility. Similarly, the large hospital with a variety of specializations may serve a large area, but individual community clinics are essential in assuring easy access to primary health care services.

Major benefit spillovers can be expected from the three public services cited earlier, along with education and public housing. Income redistribution is achieved through public financing of health care, education, and housing. The three public services thus are logical candidates for areawide (or state and federal) rather than local financing (assuming income redistribution is *not* a local function).

Table 2. Estimated income payments of institutional (Class 5) sectors to specified income-receiving sectors, West Minnesota, 1967[a]

				Local Government							
Income receiving sectors		Business 35	Household 36	County 37	Munic. 38	Township 39	School dist. 40	Special distr. 41	State gov't. 42	Fed. gov't. 43	Prop. inc. 44
						($1,000)					
Construction	24	0	0	3,927	1,270	1,412	0	0	0	0	0
Health	27	0	0	253	19	0	0	0	5,015	557	0
Education	28	0	0	991	238	0	28,455	0	9,247	1,143	0
Pub. adm.	29	0	0	6,411	1,150	352	0	206	4,381	11,300	0
Subtotal	24–29	0	0	11,582	2,677	1,764	38,455	206	18,643	13,000	0
Household consumption	30	0	340,447	0	0	0	0	0	0	0	0
Prop. tax	32	0		0	0	0	0	0	0	0	0
Household	36	10,741	0	8,462	81	91	0	0	0	21,311	10,741
County	37	0	0	0	0	0	0	0	15,776	157	0
Municipal	38	0	0	179	0	0	0	0	910	41	0
Township	39	0	0	102	0	0	0	0	160	0	0
School dist.	40	0	0	2,424	0	0	310	0	21,208	0	0
Spec. dist.	41	0	0	11	0	0	0	0	0	19	0
State	42	549	8,780	0	0	0	0	0	0	0	0
Federal	43	8,870	66,773	0	0	0	0	0	0	0	0
Property inc.	44	2,638	0	0	0	0	0	0	0	0	0
Public ind.	46	0	0	4,870	4,318	0	11,583	55	0	0	0
Household consump.[b]	47	0	20,000	0	0	0	0	0	0	0	0
Institutional	48	2,420	0	13,602	6,322	21	3,267	0	0	0	0
Subtotal	30–50	25,218	436,000	29,650	10,721	112	15,160	55	38,054	21,528	10,741
Totals		25,218	436,000	41,232	13,398	1,876	53,615	261	56,697	34,528	10,741

[a] Income payments of local government sectors to the public industry sectors cover a portion of total outlays not covered by service charges. Any remaining outlays are covered by the income payments of state and federal governments. Because of the limitations of the input-output format presented earlier, these entries were consolidated earlier in the export sector.

[b] The capital accounts of the combined institutional sector (Row 48) receive all income payments savings (business, household, and government).

Financing public services

Except for the municipal service enterprises, each public service is supported largely by local property taxes. Nearly one-half of local tax receipts were diverted to school districts in the study area. However, transfers from state government to school districts exceeded total tax income—a pattern more pronounced now than in 1967 because of an expanded educational aid program [3, p. 4]. State government in Minnesota has attempted to reduce local fiscal disparities by undertaking an increasing share of the burden of education (and, also, welfare).

Additional efforts in reducing fiscal disparities relate to two criteria noted earlier, i.e., spillover effects and income redistribution. In 1971 the Minnesota state legislature provided for the regionalization of 40 percent of the new (post-1971) property tax for local education. This particular legislation may have other problems besides being challenged in the courts, but the concept of pooling property taxes on a regional scale merits serious consideration as a means of reducing fiscal disparities and, also, costly intra-area competition for new industry [4].

Because of the regressive nature of the property tax, the pooling of the local tax base to reduce educational disparities is likely an interim solution. Logically, the financing of public education is a responsibility of state government while the financing of public welfare is a responsibility of the federal government [13, p. 173–184]. Presently, however, local governments still support a significant share of both functions.

Local Funding Alternatives

The provision and financing of rural services is viewed in terms of criteria for choosing an appropriate governmental level for these functions. Important here is the competition for local resources between the development and the maintenance functions of local governments. For rural areas, particularly, a strong case is being made for allocating a share of total outlays to stimu-

Table 3. Estimated income payments of private industry (Class 6), public industry (Class 7), household consumption (Class 8),and institutional (Class 9) capital sectors, and ecologic (Class 10) and rest of world (Class 11) to specified income receiving sectors, West Minnesota, 1967[a]

		Class 6	Class 7	Class 8	Class 9	Class 10	Class 11
Income receiving sectors		Private 45	Public 46	Household consumption 47	Institutional 48	Ecologic 49	Rest of world 50
				($1,000)			
Mining, construction	4	38,709	15,677	3,488	0	0	2,331
Food products	7	78	32	0	0	0	4,002
Lumber, furniture	8	78	32	436	0	0	6,578
Stone, clay products	10	704	285	872	0	0	1,870
Machinery	11	1,276	516	0	0	0	0
Other manufacturing	12	6,868	2,781	3,759	0	0	0
Other wholesale	16	94	38	87	0	0	0
Other	1–23	0	0	0	0	0	395,471
Other retail	26	0	0	0	0	0	362
Subtotal	1–29	47,807	19,361	8,642	0	0	410,614
Sales taxes	31	382	0	327	0	0	0
Business	35	0	0	0	0	0	0
Household	36	0	0	0	46,257	0	0
County	37	0	0	0	13,832	0	0
Municipal	38	0	0	0	5,620	0	0
Township	39	0	0	0	24	0	0
School district	40	0	0	0	12,738	0	0
Special district	41	0	0	0	195	0	—
State	42	0	0	0	0	0	24,636
Federal	43	0	0	0	0	0	—54,107
Property income	44	0	0	0	8,103	0	0
Private industry	45	0	0	0	5,428	0	0
Public industry	46	0	0	0	25,068	0	0
Household consumption	47	0	0	0	—	0	0
Institutional	48	0	0	0	0	0	36,205
ROW	50	7,657	13,935	27,031	0	0	0
Subtotal	30–50	8,039	13,935	27,358	117,265	0	0
Totals	1–50	55,846	33,296	36,000	117,265	0	417,348

[a] Income payments of the capital sectors cover the final demands of the business, household, and government sectors identified earlier in the input-output tables. Private industry (Sector 45) payments are identical to gross investment, and public industry (Sector 46) payments are identical to government purchases. Household consumption (Sector 47) payments are less than household purchases in the input-output tables (since the household sector is exogeneous to the 29 industry sectors). However, together with the current household consumption (sector 30) income payments, the two sets of payments for household consumption equal the value of household purchases under final demand.

late local economic growth and, thus, the economic viability of the local tax base [10, p. 90].

Stimulating economic growth

Local government outlays to stimulate economic growth are effective mostly when the economic problem is not to stimulate growth but to control it. Development outlays in the growing areas, therefore, are confined largely to infrastructure investment, i.e., sewer, water, streets, and schools. Land use controls are established to reduce development pressures and overextended public sector commitments to build required infrastructure on demand [2, p. 10]. The development timing ordinance is one of the newest and most sophisticated techniques for reducing the potential growth in an area.[2]

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[2] In the case of Golden v. Ramapo, the New York Court of Appeals decided in May 1972 that a municipality may stage its capital improvements program over a prescribed number of years—in this case, 18—and it may hold private developers to this rate of development [5, p. 10]. The concept that local officials would determine growth policy is being extended to a rural township in the Minneapolis-St. Paul metropolitan area [7, p. 10]. Here, a six-month moratorium on all development proposals was voted by the Town Board to give township officials time to adopt a comprehensive plan and zoning ordinance. The staged growth approach to planning was subsequently approved in May 1973.

Despite the development pressures in growing areas the financial markets react favorably to the issuance of general obligation and/or revenue bonds by local governments.[3] Use of development districts, tax-increment financing, and other new approaches to available sources of funding also is more attractive in growing than in declining areas. Again, local government is utilized to further local business interests in the guise of stimulating needed economic growth (in large part because of the heavy burden of new infrastructure development).

In declining rural areas, growth-inducing infrastructure outlays are minimal. Growth potentials are limited by external conditions which are not influenced by the local investments. Instead, maintenance expenditures are large in part because of an aging population and the heavy burden of public welfare. In declining areas, therefore, local pressures to increase maintenance outlays are difficult to resist, but the lack of economic growth gradually weakens local fiscal capabilities to support needed maintenance functions adequately.

Maintenance expenditures

Maintenance expenditures of local governments, such as health care and education, generally result in cost and benefit spillovers and income redistribution, especially for declining rural areas. Hence, a strong case can be developed for state and federal participation in financing local maintenance activities.[4] Moreover, an areawide rather than a local approach is called for in providing the essential maintenance services. User proximity, however, is an important consideration in the location of the service facilities, which may require some physical decentralization within an areawide delivery system.

In some areas, practically the entire public outlay supports maintenance activities while in others these activities may account for less than half of total outlays. If some target level of maintenance expenditures were prescribed, say 80 percent of total outlays, then an internal constraint would be imposed on the level of growth-inducing or developmental outlays and, hence, on the level of total government outlays. The division of total public outlays between growth and maintenance functions thus becomes an important consideration in the development decisions in the private sector and the financing decisions in the public sector. Citizen involvement in the local decision making processes is important, too, especially when local values may conflict with area and state goals for population growth and distribution.

Area Growth Policy

Both the provision and the financing of rural public services are constrained eventually by areawide potentials for stimulating economic growth and supporting welfare maintenance activities. Improvement in the delivery and availability of rural public services is a precondition for improvement in the economic potential of rural areas [10, p. 87]. An economically healthy community base is needed to support these services. Missing in rural development efforts in the past has been a concept of the rural area as part of a regional settlement system in which public policies and expenditures affect in varying degrees the location and distribution of population and economic activity.

Growing areas

Public services in growing rural areas may be expanding but inadequately because of rapid population and economic growth. For these areas, the deliberate implementation of an area growth policy offers one approach to the rationalization of the development process in the light of local funding constraints.

The Marshan Township experience (in Dakota County, Minnesota) is indicative of changing public attitudes to the open growth philosophy traditionally promoted by developers in growing rural areas [7, p. 4]. Unless the staged-growth alternative is the result of an open, non-exclusionary planning process, however, the courts are likely to hold that the limitations on growth are "capricious and unreasonable." The long-term capital improvements program of the local community must provide for specific staging of the construction activities and subsequent provision of basic municipal services. The objective is to reduce the public costs of private development rather than to exclude particular socioeconomic groups from future access to land and housing in the area.

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[3] In the study of local public facility needs prepared for the Joint Economic Committee (see [16]), an extensive survey was made of the sources of financing of capital outlays by State and local agencies with particular reference to the municipal securities market.

[4] A contrary view is represented in the urban economics literature which refers to the "fiscal neglect of urban areas by state government" (see [12, p. 137]). However, the measurement of spill-over benefits from local financing of public education has been neglected in this literature, along with long-term income distribution effects of rural-to-urban migration and commuting and the rural-urban incidence of state and local taxes.

Because growing rural areas typically are part of an expanding metropolitan region, the provision and financing of local public services is influenced by regional plans and programs. Much of the total public outlay for basic community facilities in the region is determined by regional boards which are concerned with capital improvements of regional impact, i.e., highways, air and water terminals, wastewater treatment plants, libraries, sports stadiums, parks and recreation areas, and public transit systems. Again, the spatial-economic interdependencies between growing urban and rural areas provide strong support for areawide planning of major public services and facilities.

Rural community participation in areawide planning is one approach to learning about alternative futures for both urban and rural communities in the planning area. Local financing problems stemming from the expansion of the urbanized area into the rural periphery would be perceived as an areawide planning problem. Restriction of the metropolitan infrastructure development to a prescribed development zone would result in additional pressures of new development in the rural periphery in the absence of an areawide approach to an urban growth policy. However, local efforts to shift development costs to the new residents (e.g., by use of an incremental treatment capacity connection charge to cover plant expansion) would reduce some of these pressures for the existing residential population [14, p. 13].

Growing rural areas outside metropolitan areas are confronted with the additional problem of being in the commuting zone of the metropolitan labor force. Here, the public costs of in-migration (from both metropolitan core and outstate areas) are evident in higher local outlays for public welfare and schools (as well as basic municipal services). However, an areawide approach to development planning and financing in this case would lack the participation of the metropolitan core area communities. The potential for controlling private development and, thus, local government outlays, would be less than in the metropolitan planning area. Here, multi-area and statewide planning approaches are needed to formulate and implement regional development plans.

Emerging from the rationalization of the development planning process is the use of population and employment targets and related land use controls for an entire multi-county planning area. The economic targets would be translated into estimates of land use requirements and population intensities. A land use plan would be implemented by zoning and subdivision ordinances and public expenditure commitments. Local development expenditures would be limited to levels prescribed in the land use and development plans.

Declining areas

Public services in declining rural areas also may inadequately meet local needs but not because of competition from growth-inducing expenditures. Here, the setting of development targets in terms of population and economic activity would depend upon the development targets established in the growing areas. Growth in public services would be guided by these targets and, also, by the availability of public financing, including proceeds from sale of general obligation or revenue bonds of local governments. A technical capability is needed, however, for simulating infrastructure development and service delivery alternatives for the declining areas in the context of the total regional or statewide settlement system.

The set of economic accounts cited earlier, when projected to a target year (e.g., 1980), help identify the infrastructure requirements of the target population and industry. All funding services for each expenditure category are identified, also.

Two obvious conclusions emerge from study of the economic projections for the target year, namely, that public infrastructure requirements are increasing more rapidly than local funding sources and that local governments are increasingly dependent on state (and federal) funds for essential public services [11]. Use of a staged-growth concept for reducing public financing requirements would be inappropriate. Instead, a statewide approach to local capital improvements programming is needed. A series of statements on statewide development prospects is envisioned which specifies in some detail the local fiscal implications of area growth policy alternatives.

Local governments in declining areas may exercise one or more options on growth policy, but in the context of statewide development planning. Statewide forecasts of funding levels and sources for local public services would be prepared as part of state-level development planning efforts.

An areawide financing approach also would improve local access to financial markets. The concept of areawide pooling of at least a part of the local tax base also would improve the fiscal prospects of declining rural areas. In addition, the new development district legislation can be used to revive the declining downtown business community in the major area service center or to build an industrial park for new industry moving into the area. Use of new funding sources, such as tax-increment financing of infrastructure development, also would be approached on an areawide scale. In this case the tax increments resulting from the additional economic activity and the expanded tax base would be used to retire the local bonded indebtedness incurred by the new infrastructure outlays.

Improved pay-off prospects for growth-inducing infrastructure outlays in some declining rural areas may lead to a reordering of financing priorities. The proportion of total government outlays allocated to growth functions would become larger as the declining areas improve their long-term economic prospects.

In summary, the prospects for local funding of rural public services are severely limited by the local tax base. In growing rural areas a strong local commitment to development results in a disproportionately large allocation to growth-inducing capital improvements and public services. In declining rural areas an aging population and lack of profitable development prospects results in disproportionately large allocation to maintenance functions.

A rationalization of public service systems is perceived in the context of areawide and statewide development planning. Public service delivery is consolidated on a multi-county area scale in the case, specifically, of wastewater treatment, hospitals and health care, and public transportation. Scale, scope, and proximity considerations determine the appropriate governmental level for service delivery.

Local funding of rural public services logically is confined to those services which are lacking in significant benefit and cost spill-over and income redistribution effects. Water and sewer lines, local streets and sidewalks, and local parks are included in this category.

In both the provision and financing of rural public services a statewide development planning approach is needed, especially in the case of declining areas. Needed, also, is a technical capability for simulating local fiscal impacts of area growth policy alternatives. Part of such a capability is a set of economic accounts for each development planning area which shows the fiscal and institutional linkages between the public and private sectors. Even more important is an ability to present alternatives and to assess their fiscal implications for local communities.

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Non-Local Funding of Rural Public Services*

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FOR MANY of us who began our careers in Community Development and Public Policy during the 1960s and 1970s, the question of "why federal assistance for public services and facilities?" seldom enters our minds. We accept the notion of federal assistance without question. The original kit of tools that we brought to our jobs included the handbooks listing the several hundred grant and loan programs applying to every development and poverty situation imaginable, and "grantsmanship" was part of our jargon. We now have to strain the back of our minds to hear the old cliches—"federal aid means federal control" and "that government is best which governs least."

And, yet, these old concepts are very much a part of the philosophy which runs deep through much of today's society. We saw it surface in the last administration with its emphasis on decentralization and the "elimination" of federal government. The public's declining confidence in government institutions reflects this emphasis.

A discussion of the role of Non-Local Funding of Rural Public Services, the status of such funding, and local community accessibility to these funds appears very timely, now that we are changing administrations. The new administration makes it possible to look more objectively at the old and to consider more openly the future.

Historical Perspective

Federal policies have historically played a significant role in shaping our nation's development—sometimes intentionally, sometimes inadvertently. During the 1800s, the federal government actively encouraged population growth in America's heartland through the Homestead Act. Our pattern of dispersed settlement on small farms and on individual home sites up and down country roads is in sharp contrast to the pattern of some of the other countries of the world where all residents are grouped in cities, villages, or large collective farms. Perhaps that decision was of minor significance in 1862, but today it has a profound effect on our ability to provide rural America public services such as education, roads, public transportation, health services, and water and waste disposal.

Another early policy was federal aid to the fledgling railroad industry, which facilitated the economic growth of the new settlements. Federal immigration policy permitted large numbers of new citizens to come to our shores prior to World War I. Had it not been for our immigration policy, the Northeast and South surely would have continued to oppose opening up the West because of competition for labor and agricultural production.

These policies played a significant role in the development of our country, but prior to the 1930s there was little federal funding of public services and facilities. The old Jeffersonian belief of 200 years ago that "power was dangerous" had prevailed, and it was thought by his followers that only those functions and powers which were strictly national in nature should be entrusted to the national government, and all others should be reserved to the states and their local units of government. Herbert Spencer's "Social Statics" of 100 years ago ". . . raised laissez-faire to a dogma among American businessmen. He had picked up a phrase of Tom Paine, 'That government is best which governs least,' and thought that the functions of the National Government should be limited to internal policy and foreign protection . . . no public education, nor limitation of hours of labor, no welfare legislation" [1, p. 771].

As a result, there were only 10 federal aid programs prior to 1930. However, in 1933 President Roosevelt, in response to a devastating depression, made a conscious effort through legislation "to enhance the welfare and eventual security of simple folk throughout the country" [1, p. 953].

One of the first major pieces of legislation relating to federal assistance to local communities was the Federal Emergency Relief Act of May 12, 1933. This Act appropriated $500 million for the direct relief of States, cities, towns, and counties. By January 1934 the Civil Works Commission, which grew out of the Act, had

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over four million people on its rolls, and at its peak 400,000 separate projects were underway: roads, schoolhouses, airports, parks, sewers—everything that they could think of that would be of public benefit.

Next came the WPA (Works Projects Administration) as part of the National Industrial Recovery Act of June 16, 1933. The WPA spent billions on reforestation, flood control, rural electrification, water works, sewage plants, school buildings, slum clearances and student scholarships. The authority of this Act also established a Resettlement Administration which initiated a wide range of housing and resettlement projects across the country. Nor were the nation's youth forgotten. Hundreds of thousands of young men were provided work training and job experience through the CCC (Civilian Conservation Corps), and thousands of acres of public forests and other lands were made available for recreation and economic use.

On May 18, 1933, TVA was created to accelerate the economic development of an entire region and raise the collective well-being of millions of people in the region.

REA is another product of the 1930s. Through low interest rate loans to rural electric cooperatives, REA had lent $434 million by 1941, and 750,000 farms had power and lights. By 1950, 90 percent of all farms were electrified, and today the figure exceeds 98 percent.

The Housing Act of 1949, which established the national goal of "a decent home in a suitable living environment for every American family," is an excellent example of legislation with a specific national goal. Unfortunately most of our domestic programs are not in response to such specific goals.

The massive Federal Highway program of the 1950s should also be mentioned as well as the legislation to aid depressed areas—such as the accelerated public works, ARA, and EDA programs.

During the 1960s the federal government's reaction to problems relating to community services and facilities took the form of hundreds of narrow categorical grant and loan programs.

The New Federalism of the 1970s has introduced revenue sharing. General revenue sharing is now in its third year, and special revenue sharing is being initiated in the form of CETA (The Department of Labor's Concentrated Employment and Training Act) and HUD's Housing and Community Development Act of 1974. In both cases funds will go to state and local units of government for broad uses within the range of the program.

Hence, for the last 40 years the federal government has been making a considerable contribution to providing public services and facilities to rural areas. State governments historically concentrated their efforts on taxation, regulations, judicial functions, and agriculture. During the 1950s states gradually became more involved in highway construction and maintenance, education, and certain health and welfare functions. In the last few years states have moved more affirmatively in these areas. Most states now provide planning assistance to local units of government. Most states now have housing finance agencies to provide loans and grants for low and moderate income housing. A few states have established development corporations to stimulate community development by assuming the initial risks; they can construct public facilities, housing and commercial facilities, and sell or lease them to public and private investors. Increasingly, states have been supplementing federal grants. In 1970, 35 states reported financing federally-aided sewer treatment plants, urban renewal, public housing, mass transportation, and airports: thus the states have been able to provide fiscal relief to some hard pressed localities.

The Rationale

Let us consider now the rationale for these programs and then look in more detail at some current programs and recent funding levels. From our historic experience, is it obvious what the objective of federal funding of local services is and what the rationale for such funding should be?

The WPA and Work Relief programs of the 1930s had as their objectives getting people back to work and strengthening the economy when the private sector was unable to do so. A byproduct was improved public services and facilities. The explicit rationale for using federal funds in this case was that the benefits of getting the economy on its feet reached far beyond the local community or government unit; hence, you could not expect the community to undertake such a program with its own funds. An implicit rationale was that the taxing power of the federal government had the capacity to fund such efforts. In either case we must recognize that these programs were essentially dealing with national concerns and responsibilities including redistribution of wealth.

Perhaps REA is the best early example of massive federal assistance for the specific purpose of providing public services and facilities to rural America. In fact, it may still be one of our best examples. Under this program, the specific goal was clear—electric power for every residence, business, and industry in rural America. It is also clear that the goal was based on an expressed priority need of rural citizens. The rationale was clear—large-scale operations were necessary to achieve reasonable economies in providing service to sparsely populated areas. Also, the decision to seek and obtain federal assistance was largely a local one, and funding was at a level where all communities that wished could participate.

The REA approach was systematic and the program thorough. Contrast this to our recent water systems programs which have had less specific objectives, a relatively low level of funding, and have been "sold" to many communities, while others desiring assistance could not get it. Our water systems have often been developed inefficiently on a community-by-community basis. In fact some communities are already attempting to consolidate some of these small units into larger systems. Why the contrast between REA's electric and FmHA's water programs? Was there a different rationale for the program; was the problem different; or, was it simply a decision to use a different approach? I think the latter.

Some of the categorical programs of the 1960s provide benefits that go far beyond the community in which they are implemented. These include manpower development programs, certain environmental improvement programs, major highway programs, and perhaps some education and welfare programs. Since only a share of the benefits from these programs accrues to the local community, strictly local funding would result in gross underfunding, hence the rationale for federal funding.

On the other hand, the rationale for many of the categorical programs of the '60s seems to revolve more around local needs not being met by responsible units of government than around any comparative advantage to the federal government. Examples would be housing, sewer, water, waste disposal, education, library, and hospital programs. When the benefits all accrue to the local community, is there any reason for requiring federal funding?

Perhaps the ease of the federal government to generate revenue through their lucrative system of taxing income was originally a factor, but nearly all states now have their own state income tax program. Perhaps also there is something inherent in our public decision making and taxation processes that causes us to allocate a smaller share of our income to the public sector than to the private sector even though the marginal utility would be greater from the public sector.

On a recent visit to Bulgaria, several of us were impressed with the large share of their gross national product which they put into the public sector at the expense of personal private consumption. I cannot help but wonder why two decision making systems come out so differently—and what is the "right" balance between the private and public sector. It appears the Bulgarians have gone too far toward the public sector, which has resulted in an extremely low level of personal, private consumption. On the other hand, when the rural areas of a relatively poor country like Bulgaria have better public facilities—community centers, public transportation, parks, theaters, recreation areas, and water systems—we too should question our decision making processes.

The objective of general revenue sharing is simply to return revenue to state and local units of government. There is no concentrating of dollars on selected regions of the county nor on a few communities so that they will get enough "new" money to build a facility, nor is there any emphasis on a specific use or national thrust. The rationale is simply that state and local units of government can best use the money and that some redistribution is desirable. Whether it results in improved community services and facilities or lower local taxes remains to be seen. It also remains to be seen which decision-making structures in the community will be reinforced—those of the traditional establishment or those more representative of the disadvantaged who are most apt to have needs that are not being met.

Special revenue sharing programs, such as CETA, the manpower program, do concentrate dollars into a program area, thus possibly benefiting those who have the greatest need for basic facilities and services and lessening the probability of simply reducing state and local taxes.

Hence, with regard to the objectives and the political and economic rationale for federal funding of rural public services, it seems to me that the attitude of the federal government has evolved from one of "hands off" to one of "we'll help if absolutely necessary," to one of "if it needs doing, we'll do it," to "here, you take the money and do with it as you like."

There is one final rationale for federal involvement in providing community facilities and services which we must not overlook. We have discussed certain facets of the economic, social, and political rationale, but there is also a judicial rationale. This relates to the interpretations of the 14th Amendment to the Constitution issued by the Supreme Court during the past 15 years. This Amendment, guaranteeing equal protection under the law to all U. S. citizens, has been interpreted to apply outside the judicial system as well as within it. It applies to state and local efforts to provide community facilities and services to all citizens and to achieving equity between states in the provision of some kinds of facilities and services, e.g., transportation, communications, environmental protection, and equal employment opportunities, particularly in governmental services.

Current Programs

Let us look further at some of the federal programs that are available to assist local communities with public services and facilities. Consider also the rationale for each and to what extent each contributes to the two overall objectives of Rural Development: to improve the quality of life for those who live in rural areas, and to reduce or reverse rural-to-urban net migration, in order to achieve a population more evenly distributed.

Let us begin with the Rural Development Act of 1972. It was the product of several Senate hearings held across the country, over 100 separate bills introduced into the House and Senate, and months of Congressional consideration. Its stated purpose is: to provide for improving the economy and living conditions in rural America.

The Rural Development Act authorized three new major programs for funding rural development: (1) guaranteed loans to encourage jobs by promoting the establishment of business and industry in small towns and rural areas, (2) grants to assist communities in attracting industry, and (3) loans for community facilities that would improve rural life. FmHA's FY '74 records show that:

> FmHA guaranteed 399 business and industrial loans for a total of $200 million which created an estimated 19,300 jobs with an investment of nearly $10,000 per job.
>
> FmHA made 136 industrial grants for a total of $10 million. The business and industrial loans and grants are to develop or finance business or industry, increase income and employment, and control or abate pollution. Those eligible for loans are legal entities, including individuals and public and private organizations, in rural areas and towns of up to 50,000 people. The grants are only available to public bodies.
>
> FmHA made 102 community facility loans to public agencies and non-profit corporations for a total of $50 million.
>
> In addition to the above programs authorized by the Rural Development Act, FmHA loaned $470 million for 1,326 water and waste disposal projects serving about 330,000 families in rural areas and towns and cities up to 10,000 population and made grants of $24 million for 241 water and waste disposal projects.
>
> FmHA made loans of nearly $1.8 billion to construct, purchase, or improve more than 100,000 homes and apartments for rural residents of low or moderate income.

Other federal programs providing major funding for rural public services and facilities during FY '72, according to the *Fourth Annual Report of the President to Congress on Government Services in Rural Areas* [2, pp. 37–39], include:

REA electric and telephone loans of $532 million

EDA loans for business and development companies of $24 million

SBA loans for small businesses of $559 million

Department of Commerce grants of $125 million primarily for EDA and regional commissions to facilitate economic growth in depressed areas through public works, planning, and technical assistance

Department of Justice grants for law enforcement assistance of $89 million

EPA grants of $140 million for waste water treatment works, $3.6 million for air pollution control, and a half million for solid waste planning

OEO expenditures of $108 million for concentrated community development and community action

Transportation expenditures of $2.1 billion for highway construction and studies, beautification, and mass transportation

HUD urban renewal and neighborhood facilities programs of $212 million

HEW health facility construction of $18 million

HEW elementary and secondary education of $654 million

HEW and OEO health programs of $253 million

HEW welfare of $2.4 billion

HEW medical assistance of $1.3 billion

Labor employment and manpower training and development programs of $748 million and HUD and VA housing loan programs of $2.1 billion and grants of $1.6 million.

General revenue sharing of $30.2 billion for the total U. S. includes about $8 billion for the rural areas for the five years 1972–1976. This is equivalent to an average of about $30 per capita per year and is distributed to 50 states, the District of Columbia, and 38,700 active units of local government.

As for the Universities, Title V of the Rural Development Act is the first brick-and-mortar Rural Development legislation to contain an educational component. Its purpose was to generate and extend scientific knowledge and information relating to Rural Development so that local communities would have the best information and understanding possible upon which to base their community decisions. Although administered by the 1862 Land Grant universities, all public and private colleges and universities are eligible to participate in the state plan of work to the extent funds are available and a meaningful contribution possible.

Although the three-year authorization for the Act was $10 million in FY '74, $15 million in FY '75, and $20 million in FY '76, the FY '74 appropriation was for only $3 million, as was the FY '75 appropriation contained in the recently-vetoed Appropriations Act. This provides states from about $15,000 to $105,000—half being for research and half for extension. As a pilot effort it is assumed that if state programs prove successful, the legislation will be extended and expanded.

The above listing and data account for over $15 billion and about 140 of the major federal programs providing assistance to rural areas. Although these are the major programs, they are only about one-fourth of all programs available to rural areas.

For the above data "rural" is defined as nonmetropolitan plus those counties within metropolitan areas with population densities of less than 100 per square mile; this accounts for 27.2 percent of the U. S. population.

Accessibility

The multitude of categorical programs creates a difficult problem for rural communities. Rural areas are less likely to have capable, full-time grantsmen than the larger urban centers. They simply cannot compete effectively. Therefore the rural areas have been less apt to seek federal assistance unless their problems are critical to the community's needs and assistance is demanded by local citizens. As a result, federal agencies have found it necessary to go to the rural community and "sell" their programs to communities with the capacity to absorb them, regardless of the need—while other, usually smaller, communities which need and want the assistance cannot get it. Often the costs of getting assistance are more than the small rural community can bear. And too often the needs of the small rural community are not provided for in the multitude of grants and the mitigating conditions under which assistance is given.

The major problem with the federal categorical grant system may be summed up thus: (1) the federal government has determined on the basis of the macro community—the nation as a whole—what rural communities need and has provided for these things with programs and conditions that make sense on the macro scene; and (2) experience with the categorical grant system has shown us that what is good for the nation as a whole is not necessarily good for an individual community, particularly the smaller rural community.

Nevertheless, we have categorical programs and will for some time to come. One of our responsibilities, it seems to me, is to assure that community citizens and leaders and local units of government have maximum information regarding the availability of, conditions for obtaining, and procedures for securing federal assistance, that rural communities become proficient in articulating and documenting their cases before applying for assistance, and that they understand the impacts and costs to the community before deciding to proceed.

The Extension Area Community Development Agent should be an excellent source of information on programs that are currently available, the procedures for making applications, and to whom local officials should talk. Each area CRD agent has a Catalog of Federal Domestic Assistance. Most County Extension Agents can assist in getting local officials or leaders to the appropriate source of information—state, county, or area Rural Development Committees, local or state offices of the agency involved in a categorical program, or sub-state planning and development agencies. University faculty members with extension-related responsibilities ought to be familiar with federal programs in their subject matter areas. The sub-state planning and development agencies, especially those with A-95 Clearinghouse responsibilities, should also be familiar with the programs available, and they should be able to assist with applications for projects.

I should mention that efforts like those suggested above over the past several years have resulted in rural communities receiving more nearly their fair share of federal assistance based on population distribution. We see this trend continuing. Of the programs mentioned above, rural areas were least apt to get their share of housing and manpower programs—only about half—but they were receiving nearly their fair share of most of the other programs [2, pp. 3–5].

Future Trends

As we look ahead, we see Congress emphasizing its categorical programs, the administration pushing hard for decentralization and revenue sharing, and hopefully both facing up to the inflationary effect of federal spending. HUD's Housing and Community Development Act and Labor's CETA are examples of the administration's revenue sharing approach. At the same time, Congress appears about to extend and broaden EDA's authority for two more years.

Another trend that appears to be continuing is that of consolidating similar programs. Agriculture no longer asks for money for nonmetropolitan planning. Most planning has been shifted to HUD. HUD, on the other hand, no longer funds sewer systems. This is now handled by FmHA, EPA, and EDA. Another accomplishment is that these three agencies all accept the same application form and any one agency will refer an application to another agency if appropriate.

More emphasis will be put on guaranteed loans rather than grants or direct loans. In Alabama we have seen the state use some of its general revenue sharing dollars to supplement the federal sewer and water programs. This is indicative of a slight trend for states to play a larger role in financing local services and facilities in addition to the traditional education, welfare, and highway programs.

The demand for the universities' assistance in helping communities develop the capability for solving their own problems will continue to grow. The need is especially great under New Federalism. Communities want help in developing a broad leadership base, organizing viable organizations and structures of government capable of dealing with their development needs—and the public officials, community leaders and lay citizens need the best knowledge and technical information available. The Agricultural Experiment Stations are now devoting about $13 million to RD research, and Extension is devoting about 9 percent or $36 million of its resources to community development. Our FY '74 Title IX report shows a 10 percent increase for Extension CRD work over FY '73. This has occurred without additional federal dollars earmarked for CRD.

Some expansion in Extension CRD programs will likely continue to come through hiring new CRD staff, and a substantial expansion will likely come through existing staff at the county, area, and state level devoting a larger share of their efforts toward the solving of community problems.

In conclusion it appears the federal government will continue to channel huge sums of money back to local communities. The form will be decided on the basis of available knowledge and the political processes of the time. A better rationale upon which to base the funding decisions and better strategies for development are sorely needed. These are opportunities for the best minds at the universities.

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Financing Public Services in Rural Areas: A Synthesis

B. R. EDDLEMAN

RAPID CHANGES in technology, shifts in population, changes in the price and availability of resources, and changes in the institutions and organizations providing goods and services have resulted in a geographical redistribution of population and economic activity. Rural residents who were unable to, or who chose not to, migrate from their communities have not received an equitable share of the income and capital values generated by these changes in the U. S. economy and public investments. The result has been fewer people left to support the existing social, economic, political, and cultural institutions in rural America. Per capita costs of maintaining health facilities, schools, police and fire departments, water and waste disposal systems, local government, churches, social welfare services, and a host of other community services have risen sharply. These recent changes in the structure and organization of the American society have caused federal, state, and local area decision makers great concern on how to finance and provide public services to rural people in the face of rising service costs and a declining, constant, or slowly rising tax base.

Heady and Whiting [2] and Tweeten and Doeksen [8] have also identified the problems of most rural communities as being those of inequities falling on the nonfarm rural people with regard to income earning opportunities, underemployment, human services, and welfare conditions. The ultimate solution to these problems facing most rural communities is seen as a "long-run restructuring of settlement, economic, and administrative patterns, along with equal claims to public investment in environmental and social services . . ." [2, p. 6]. Jones and Gessaman also recognize these long-run aspects of the problem and view consolidation of public service delivery systems as a short-term, but not universal, solution to problems of rural service delivery. Maki has pointed out that the public services of sewage disposal, hospitals, health services, as well as education, housing, and road maintenance are prime candidates for consolidation on an area wide basis.

The development of a rural community can be influenced by local public decision makers mainly through programs relating to the planning, financing, and physical production of public services. Local decision makers who formulate investment programs need information on the effects of alternative courses of action in order to make the most effective use of all available resources for providing public services to the community's residents. With the possibility of increased non-local funds from federal and state governments, there is need to evaluate alternative courses of action in providing public services in rural communities.

In order to plan the investment and production of public goods, local decision makers must be provided with information on the community's existing and projected population—described by various characteristics such as age, occupation, ethnic composition, income, employment, and labor force, as well as the population's demands for public services. Other information essential for effective program planning includes projected government revenues and annual operating expenditures, tax base, consumer expenditures, income distribution, investments, and industrial output. Decision makers also must have an idea of those instrumental variables and key relationships that can be influenced to bring about changes required to achieve the needs or demands of the community's residents for public goods. The development of rural communities is most effective when public policy efforts that have been directed toward meeting the public service needs of existing residents result in an improvement of the environment and attractiveness of the community to business firms and households through better education facilities, health and medical services, transportation systems, tax structure, and so forth.

Decision Making Framework for Financing Public Services

This paper will attempt to identify the essential components of a decision making framework to evaluate alternative processes for financing

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and providing public services in rural communities. I will draw upon many of the ideas presented by Jones and Gessaman, Maki, and Bottum. Local decision makers need to be able to determine whether or not a community has sufficient resources to provide for the public service requirements and demands of its residents. The decision making framework must be capable of selecting from among the feasible investment programs which provide alternatives for meeting these requirements. It is important to know if it is economically feasible to provide the public facilities required to make rural communities attractive places to live and under what technology and organizational arrangement. Of particular relevance are such considerations as:

(1) Policies about the pattern of public facilities development in local communities. What kind of public services can the local communities sustain and what kind of specialized services need to be provided by a nearby urban center or by a regional service organization?

(2) Programs for supporting public services in rural communities. What financing and production plans are necessary to meet the demands for housing, education, health and medical care, parking, transportation network for commuters, shopping centers, waste disposal, and open space? What is the optimal size service district for varying amounts of population density of these services under alternative institutional arrangements?

(3) Programs for maintaining necessary minimum quality in the environment. What is the influence of environmental quality problems on the location of public facilities and settlement patterns? To what extent can local communities and rural areas serve as open space and recharge areas for reincorporation of waste materials back into the natural environment?

(4) Complications for policy and feasibility analysis resulting from the fact that public services may be complementary, competing, as well as independent. What are the trade-offs both over time and space between various types of public services within given financing limitations? What effects do these trade-offs have on the exercise of local decision making and on opportunities for coalitions among interest groups? How do they influence unit cost analysis of providing public services?

Answers to these types of questions would provide guidelines for public service programs directed to rural communities. Specific answers to problems concerning the time, place, form, type, and institutional structure of public service investment program alternatives must be provided to decision makers in rural areas. Such information would also meet the needs of state and federal agencies who either provide technical assistance or financial assistance for public facilities in local communities.

In general a decision framework for providing information for effective local planning and financing of public services in local communities would need to include:

(1) Identification and formulation of general community objectives and the specific objectives of all important segments of that community with regard to providing specified kinds and amounts of public services.

(2) Identification of the potential power of each community segment, the degree to which it is mobilized, and the channels through which it is exerted.

(3) Determination of the current and projected level of local public investment funds available for the financing of public services in the area.

(4) Evaluation of alternative investment programs and organizational structures for providing specified kinds and amounts of public services with area resource and capital availability constraints.

(5) Identification of any differences between the projected level of local government revenues and the level of public financing required to meet the specified kinds and amounts of public services. Evaluation of alternative means for the financing of these services through state and federal programs.

The informational components of the decision making framework will consist of a set of exogenous variables, a set of technological and behavioral relationships, and a system for valuing both policy actions and their consequences.

Exogenous variables are those economic, demographic, social, political, physical, and other characteristics which are not affected by the plan, although they may influence the plan and do influence its consequences. One group of exogenous variables is distinguished by the fact that local policy makers are able to control or change the magnitude of the variable. These are the policy instruments and need not be represented by a single variable but can be represented by a complex relationship, such as the tax system or local government revenue system portrayed by Maki. The other group of exogenous variables is not under the control of the policy maker but does influence the plan. Levels of these non-controllable exogenous variables must be either given to the policy maker or conducive to forecasting procedures.

Technological and behavioral relationships describe the interaction of the local economy and the public service outputs and determine the effect a change in the exogenous variables will have on the area endogenous variables. These relationships are the production functions and cost functions for producing public services under alternative organizational arrangements as described by Jones and Gessaman.

Endogenous variables describe the results of alternative courses of action. Those variables which directly affect the characteristics of the local economy and the level of public service finances that the policy maker wishes to change are goal variables. Other endogenous variables which are affected by the decisions, but within the ranges are not of concern to the policy maker, are irrelevant.

Due to the limited nature of the policy variables available to local decision makers, physical planning is the major type of planning undertaken at this level. Local decisions usually involve the efficient and equitable distribution of public services and financing burdens. This does not mean that local communities cannot influence their growth, but it does mean that most policies influencing area incomes are under federal and, to some extent, state control. Efficient physical planning is probably the most important policy means available to local public decision makers for influencing growth. Local initiative and enthusiasm as expressed through providing adequate public services at least cost is important in providing the climate conducive to private and public business investment.

The ultimate research effort involves the formulation and application of an empirical model to evaluate the economic feasibility of alternative public services investment programs in a study area. Time-related mathematical programming techniques permit one to select alternative social investment activities (such as net additions to existing classroom space; hospital and medical facilities; medical, health, and general adult education programs; public utilities; and transportation facilities) to optimize some specified objective function such as to minimize total public cost or total capital investment. Such a decision model requires transformation relationships between a list of resource commodities available to provide public services in an area and the required inputs of these resource commodities to produce a unit of specified public services output. The resource commodities in an area constrain the optimization process and include such things as the available economic tax base, social overhead capital investment funds, and perhaps labor of special skills including medical doctors, nurses, and public school teachers.

Shadow prices provided by the solution of the model may be interpreted as the marginal value product, MVP (the value to the area of an extra unit of a resource commodity), of each resource commodity. The MVP's provide the basic ingredient necessary to solve both the problems of efficiency and allocation of an area's resources to meet the public services requirement of its inhabitants.

An alternative formulation would be the type of interindustry transactions analysis presented by Maki. Such a framework effectively ties the public services sectors to the area economy through local revenue generation and local revenue spendings to support these services. Factor intensity coefficients, as well as tax intensity coefficients, may be developed from these transactions tables and used to determine the impact of growth in output going to final demand on the public service output and local revenue requirements. Conversely, by setting target levels of public service outputs based on local population targets, the required expansion in economic activity necessary to generate the funds necessary to reach these public service output levels may be determined. Such an approach is being attempted by EDD in the Human Resource Adjustment Study of the Coastal Plains Region in North Carolina.

Irrespective of the actual form of the model, several functions and/or variables crucial to formulation of a public services decision making framework must be considered:

(1) Goals: What does the community or its segments want?

(2) Capital Budgeting Alternatives: What alternative ways may public services be provided and financed? What organizational structures are feasible and acceptable to the local community?

(3) Constraints: What are the limits on actualization?

- A. Economic: What public finance level will the economy support?
- B. Socioeconomic: What restricted resources, scarcities of specialized personnel, etc., limit levels of particular services?
- C. Political: What collection of interests

can force or block a particular decision?

D. Systemic: What minimal level of service must be met?

E. Legal: What alternatives are prohibited?

(4) Investment Activities: What is the marginal unit cost of each public service?

(5) Time Dimension for the Planning Process: What future time period would the public facilities decision process encompass?

Each of these questions must be considered in developing the informational requirements of the decision making framework. Each, in some ways, becomes a separate phase of the investigation. Some of the informational requirements and suggested approaches for obtaining them are briefly described.

Identifying Community Objectives and Constraints

Economic, political, and sociological theory, as well as certain statistical procedures, would be required to identify community objectives regarding the provision of public services and to measure the effects of those factors that are causing the historical growth in public service output to fall below the estimates of needs or demands for public services by area residents.

A sample survey would be required to discover what public services the public desires and how badly they desire them. A portion of the value measurements would probably be in terms of broad, generalized desires described by Kluckhohn and Strodtbeck [4]. Other items would deal with specific goods and services. Surely all public services are desirable; the results will fit the realities of policy only if they measure intensity and priority of choices among competing goods including negative goods such as additional taxes. The instrument for measuring values might utilize a "forced choice" technique [5]. This format would yield data easily transformed to interval scores, a necessity if they are to fit into an empirical decision making model.

In addition to values the instrument would need to include questions concerning to whom the respondent turns or what actions he takes when he wishes to influence a public issue, as well as the usual fact sheet on age, sex, and occupation. One would assume a collection of population segments that differ in economic and social characteristics and in values. The sampling plan would then be designed to obtain sufficient observations in segments of different ages, sex, occupation, social class, race, and residential location. For many purposes it may be possible to collapse these into substantially larger subsamples. If, for instance, preliminary analysis showed that virtually all rural families took the same position on a particular issue, the sample could be treated as only two sub-samples.

The components of the decision model dealing with the transformation relationships to convert resources into public investment activities require multidisciplinary work to formulate these behavioral and technological relationships. Regression techniques and cost engineering would be required to established the relationship for the production function of each type of public service considered.

Hirsch [3] has indicated the structure of production functions of public services. Output is viewed as a function of quality factors, input factors, service conditions, and state of technology. Inclusion of quality variables permits partialing out the relationship between quality variation and the dependent variables measuring output. Input factors may be divided into labor and capital. Several divisions of labor (allowing for management and alternative skills) and capital (indicating the input of alternative types of capital) may be necessary. Service conditions refer to population density, types of roads, and a variety of other physical, human, financial, legal, and political factors affecting the ease of providing a given quantity or quality of service. Alternative technologies (i.e., organizational arrangements) may not be important for some services, but the provision of alternative transportation modes for travel to service producing centers is one example of the possible importance of this variable.

Given a public service production function, the agency average unit cost function can be defined. Alternatively, the cost function can be estimated directly. The long-run average unit cost of a given service is affected by quantity, quality, input, prices, shape of the input-output surface, the technology used, and the institutional structure of the producing organization. Estimates of minimum average cost per unit of service would need to be made using appropriate budgeting and statistical techniques. These cost relationships reflect short-run average cost curves, and selecting the most efficient short-run facility for alternative sizes of area served provides estimates of economies of size in providing the service.

Previous studies generally have dealt with only single independent functions of local governments. The decision framework would need to include simultaneously all major public service functions such as law enforcement, fire protection, sewer and water, garbage collection and solid waste disposal, transportation, and educational and health services and investigate the trade-off of these functions over time.

An integral part of the decision making framework consists of the specific policy alternatives available to local decision makers in the financing of public services. Alternative local government revenue generating activities would need to be specified so as to include such programs as variable tax rates, various tax structures, sale of bonds, cost sharing with state and federal governments, and capital borrowing in the private market required to maintain existing service output and to finance the construction of additional public facilities. The decision making framework must be capable of selecting from these various policy alternatives those that are economically feasible and efficient within the specifications of area resource restrictions, specified levels of various types of public services, quantifiable area or community goals, and accessibility to various groups of people in the community.

The components of the decision model dealing with the area resource restrictions require multidisciplinary work. One set of components is the social, political, and legal restraints.

The technique of community power structure study has been elaborately developed [7]. One might elect nomination rather than an issue resolution approach, if he is interested in the whole range of public decisions rather than one or a few. Given the geographic dispersion of the population in rural areas and the diffuseness of power in such a system, one could select as first respondents the office holders and persons most frequently mentioned in the general population survey discussed previously. Later interest should be focused to those nominated as powerful by this initial sample.

After identification of a power elite, each member must be identified with particular interests and his power must be quantified. Techniques here are much less well established, but models have been suggested by Schermerhorn [6] and Gorman [1]. These results would need to be integrated with the data from the population survey to show what population segments have access to what channels of power and how effective is their leverage.

Another component of the constraint variables is represented by the specified level of the various types of public services. The level of these services may be specified so as to meet the minimum needs of the population as a lower bound and to meet the demands of the population as an upper bound. Identification of these lower and upper bounds would depend on the values that members of the community place on differing amounts of public services being afforded to them and their willingness to pay for these services.

A final component of the constraint variables is the capability of the area to support higher levels of public services output through local public expenditures. This would require study of the area's economy and tax base to establish meaningful relationships between tax base and public service expenditures.

Evaluating Alternative Means of Financing Public Services

For specified levels and rates of growth in population and tax base, such factors as the kinds and quantities of necessary public investment capital; labor or specific skills; investment in physical facilities such as buildings, transportation facilities, and public utilities; and equipment investment for providing public services to the area's residents would need be determined. Recommendations with respect to local, state, and federal policies and programs to provide the area's residents with specified levels of public services would be anticipated.

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Session 5

MEASURING THE REALITY OF MODERN AGRICULTURE: NEW CONCEPTS AND STATISTICAL SYSTEMS

CHAIRMAN: JAMES T. BONNEN, MICHIGAN STATE UNIVERSITY

Concepts of the Agricultural Economy and Economic Accounting

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THE AMERICAN Agricultural Economics Association devoted a full seminar session at the 1972 meetings to discussing "our obsolete data systems." At that time the AAEA Economic Statistics Committee pointed out quite vividly that the ". . . conceptual foundation of the [data] system is crumbling—and has been for some time" [1, p. 867]. The Economic Research Service, USDA, has also been exploring problems associated with economic accounting in the food and fiber sector [2, 4]. Thus, economists both in and out of government have been concerned about economic accounting for agriculture and the future direction it should take. The purpose of this paper is to suggest new conceptual views of the food and fiber sector and its implications for accounting systems.

Certain caveats are in order. The subject will be presented only in rough outline form. Volumes have been written on accounting in economics as the subject is both "broad" as well as "deep." We shall start with the premise that we are suggesting an ideal system; for it is recognized that at times ideals must be sacrificed in the real world. Many problems exist in implementing the suggestions below, one of which is the lack of data on some elements. The discussion will be limited to aggregate economic accounts for the food and fiber sector within the national economy. Many of the side issues that can be raised while discussing the topic of economic accounting will not be explored.

What is meant by the food and fiber sector? Basically we are referring to the production, processing, and distribution of domestically produced food and fiber products.[1] Also included are those industries which provide direct inputs for domestic food production. For example, fertilizer and farm machinery manufacturing might be defined in the sector while primary steel production would not.

The word "agriculture" also presents a problem. Agriculture means many things to many people, but most frequently it is a synonym for farming. The word "agribusiness" is typically used to denote nonfarm activities within the food and fiber sector. In this paper, agriculture will be used as a synonym for the food and fiber sector. Thus, farming is a subpart of agriculture.

The paper has two basic sections. In the first, the present concepts of agriculture as portrayed in the farm income, balance sheet, and marketing bill series are sketched and discussed. In the second, alternative concepts of agriculture are presented and implications for economic accounts explored.

Present Concepts and Accounts

The farming subsector is currently viewed as a single national family farm for accounting purposes. The national family farm encompasses both household and business activities. This concept provides the basic format for the farm income series and the balance sheet for the farming sector—all of which were developed in the early 1940s [11, 14]. Processing and distribution activities associated with domestically produced food are monitored with the marketing bill published in [12]. The marketing bill, again developed in the early 1940s, is a series designed to

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[1] The following definitions will be very general rather than specific. At some future time someone must be concerned with what is specifically included in the food and fiber sector and what is not.

explain the difference between consumer expenditures for domestically produced food and its farm value. These three series cover the current aggregate economic activity of what we call the food and fiber sector. Although these series have been and are being improved upon, they still maintain the basic generic properties given them at conception.

Farm income series

The income series published in the *Farm Income Situation* (realized net farm income, income of farm operator families, and the disposable personal income of the farm population) were all basically designed to measure the income of farm people.[2] However, realized net farm income is also used as a primary barometer of business activity in farming.

The format of the income series is much like that used by farmers for federal income tax purposes (Table 1). Gross income comes from the sale of farm commodities, government payments, realized nonmoney income (food and fuel consumed in farm households and gross rental value of farm dwellings), and other minor sources. Current production expenses including fixed costs and net rent paid nonfarm landlords are deducted giving realized net farm income. Realized net farm income is the figure which is popularized in political circles purportedly being a barometer of both business vitality and the "well-being" of farmers.

Once the aggregate realized net farm income is determined, a per farm figure is obtained by dividing by the number of farms. Part of the concept of a family farm dictates that each farm be operated by a single family. Thus, realized net farm income per farm is transformed into net farm income per farm operator family via this identity. This whole procedure, apparently based on conventional wisdom, injects family characteristics into a nonhuman entity—the farm.

Table 1. Components of the U. S. farm income accounts, 1972

Item	Billion dollars	
Realized gross farm income:		
(a) Cash receipts from marketings:		61.0
Livestock and products	35.7	
Crops	25.3	
(b) Government payments		4.0
(c) Realized nonmoney income:		4.3
Food and fuel	0.8	
Rent on dwelling	3.5	
(d) Other income[a]		0.6
Total		69.9
Production expenses:		
(a) Current operating expenses:		36.7
Other farms (feed, seed, livestock)	16.3	
Nonfarm origins[b]	20.4	
(b) Depreciation, interest on real estate debt, property tax		13.2
(c) Net rent to nonfarm landlords (NFLL)		2.5
Total		52.4
Realized net farm income		17.5

Source: [13].

[a] This item was added to the accounts as a result of revisions made in 1973. Other income includes customwork and machine hire, and income from recreational services.

[b] New expense items were added for the first time based on 1973 revisions. They include expenses for customwork and machine hire, outlays for record keeping and tax return preparation, legal fees, advertising, and dues to farm organizations. Other expenditure items were modified to account for new benchmark data recently available.

In fact, the "one farm—one operator" assumption is also carried along in our data gathering activities. For example, two or more families may be involved in operating a farming partnership. The Bureau of the Census, at Agricultural Census time, will collect all the biological and business information concerning the farming operation. But they must also collect additional economic and demographic information on a farm operator family. Such data will typically be obtained from the senior partner only. Back in Washington, as the data is edited and processed, the partnership will slowly take on all the characteristics of a sole proprietorship. Sure enough, the final report shows the number of farm operators exactly equaling the number of farms.

Other deep-rooted beliefs are incorporated into the system of national accounts for agriculture. This concept of the farming sector makes it difficult to incorporate the notion that nonfarm activities can be carried out on farms. In addition, although the data used to compile net farm income includes the agricultural output of nonfarm establishments, there is no specific recognition of this in the system of accounts.

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[2] The level of net farm income has long been of major policy interest, and extensive effort was exerted to measure that variable. Interest was particularly strong following World War I when the farm economy went into severe recession. Although the *Farm Income Situation* was first published in 1940, estimates of the incomes of farmers date back to at least 1913. The farm income series today still reflects this basic purpose.

The use of the "farm gate" is particularly important in the accounting system for the national family farm. Only those transactions which "cross the farm gate" are recorded. For those integrated sectors, such as broilers, where the concept of a farm gate is vague, to say the least, we "quietly" manufacture one to make sure the whole system is consistent. Thus, increases in real cash receipts, excluding price effects, could come from either increased total output from resources committed to farming or increased specialization among farms with more commodities crossing the farm gate.

The use of a cash accounting technique, where expenses are recorded when they occur, has also led us into another problem in accounting for production expenses in the farming sector. In many cases expenditures for current output and for capital formation are not appropriately identified. Most investments in livestock breeding herds, orchard and vineyard development, and land improvements are not capitalized in the accounts. Thus, for example, if livestock expenses increase, there is little indication of whether basic breeding herds are being expanded or that more feeding livestock is crossing state lines. In fact the use of the state line as the point of measure may be causing an understatement of livestock transfer activities. Intrastate sales of livestock between farms cancel out under the current system and are not recorded.

There are also problems with using the farm income series to reflect the income of farm people. For example, part-time farming has historically been viewed as a way of either entering or leaving full-time farming. This view leads to the proposition that farm people take nonfarm jobs out of pure necessity and then only when all labor requirements for the farming operation are met. Even though off-farm income per farm operator family has exceeded realized net farm income in four out of the last eight years, off-farm income is still treated rather incidentally in the accounting system.

Because the farm population is becoming more heterogeneous, the concept itself is becoming less meaningful. For most farm residents farming is not their principal occupation. As late as 1970 only 40 percent of those families living on farms reported farming as their major occupation [9]. Of those who were farmers and farm managers by occupation, over 20 percent lived off the farm. There appears to be considerable difference between the income gains of farmers and farm manager families (an occupation concept) and farm families (residence concept) since 1960. The farm residence concept no longer gives a clear picture of the income position of people depending on farming for a living.

Farm income estimates are also used in the official National Income and Product Accounts maintained by the Department of Commerce (USDC). However, the information is rearranged in a value added framework in order to make the data consistent with GNP concepts (Fig. 1). This provides a good example of using data for purposes for which it was not designed. Thus, national income originating in farming differs from farm income estimates made in USDA.

Balance sheet of the U. S. farming sector

The *Balance Sheet of the Farming Sector* is a unique publication; no other sector in the U. S. economy has asset and claim information compiled in a similar fashion [14] (Table 2).[3] There is considerable difference between the national family farm of the farm income series and that of the balance sheet series. Farm related assets and debts of nonfarm landlords are included in the balance sheet series. Nonfarm landlord items are excluded from net farm income. Household assets are also included in the balance sheet. Many nonfarm assets of farm operators, such as nonfarm businesses, corporate securities, cash value of life insurance, and money in savings and loan associations are not included in the balance sheet. The balance sheet is for the 48 contiguous states, farm income covers 50.[4] Thus the balance sheet reflects no readily identifiable industry or group of people.

Marketing bill

Like the farm income series, the marketing bill was designed for a specific purpose: to explain the difference between the costs of U. S.

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[3] The balance sheet was a product of a study launched in 1944 to determine the impact of the war on the financial structure of the farming sector. Considerable effort has been made to improve the series, but, like the farm income series, the balance sheet still maintains its same conceptual base. Assets and claim information is available for other industries from the Bureau of the Census, Federal Trade Commission, and the Internal Revenue Service. These data are based primarily on reports and questionnaires completed for the respective agencies.

[4] A 50-State *Balance Sheet of the Farming Sector* is currently being developed and should be released within the year.

Farm Income Situation	*Gross Farm Product Account*
Cash receipts and CCC loans	Cash recepits and CCC loans
+ Goverment payments (GP)	
+ Farm perquisites (food, fuel, house)	+ Farm perquisites (food, fuel, house)
= Realized gross farm income	
+ Net change in inventories	+ Net change in inventories
= Total gross farm income	= Total value of farm output
— Current operating expenses	— Intermediate product
Feed purchased	Feed purchased
Livestock purchased	Livestock purchased
Seed purchased	Seed purchased
Fertilizer and lime	Fertilizer and lime
	Net repairs
Total repairs	Total repairs
	— Registration fees
	Net miscellaneous expenses
Total miscellaneous expenses	Total miscellaneous expenses
	— Interest on nonreal estate debt
	— Grazing fees
Hired labor-cash (perquisites are below)	Hired foreign labor (USDC)
	— Gross rents (nonfarm landlords)
— Net rents (nonfarm landlords, ex. GP)	Net rents (nonfarm landlords, ex. GP)
— Government payments (nonfarm landlords)	Depreciation (nonfarm landlords)
	Taxes paid (nonfarm landlords)
	Farm mortgage interest (nonfarm landlords)
	+ Other items (USDC)
— Perquisites paid hired labor	Perquisites paid hired labor
	Federal fines
	Less social security
	Less interest received by farmers
	Adjustment factor
	= Gross Farm Product
	— Net depreciation + damage
— Total depreciation + damage	Total depreciation + damage less depreciation + damage (nonfarm landlords)
	— Indirect business taxes
— Taxes on farm property	Taxes on farm property
	Registration fees
	Grazing fees
	Less taxes paid nonfarm landlords
— Interest on farm mortgage debt	
	+ Government payments (except GP to nonfarm landlords)
= Total net farm income	= National income originating in farming

[a] Relationships developed here are subject to change as a result of revisions currently underway in BEA.

Figure 1. Reconciliation of farm income situation accounts and BEA gross farm product and national income account[a]

produced food to consumers and the returns to farmers [12] (Table 3).[5] Currently only domestically produced foods are included: meat and dairy products, poultry and eggs, fruits and vegetables, bakery products, and other miscellaneous foods. Also included are foods purchased in away-from-home eating establishments and bought directly from farmers, processors, and wholesalers. Thus, a substantial part of cash receipts to farmers is not covered in the series (Fig. 2). Likewise neither is all food consumed in households reported.

The Bureau of Economic Analysis (USDC) estimates the personal consumption expenditures for food. From this figure ERS subtracts imported foods, seafoods, other food not produced on farms, alcoholic beverages, food consumed on farms where produced, and food furnished members of armed services. ERS then adds in the value of food served at institutions and food

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[5] The current series was first published in 1945; however, USDA research on the topic dates back to 1929. ERS is currently expanding the scope, coverage, and detail of the marketing bill concept.

Table 2. Balance sheet of the U. S. farming sector, January 1, 1973 (48 States)

Item	Amount Billion dollars
ASSETS:	
Physical assets:	
Real estate	258.7
Non-real estate:	
Livestock and poultry	34.2
Machinery and motor vehicles	39.0
Crops stored on and off-farms	14.1
Household equipment and furnishings	11.0
Financial assets:	
Deposits and currency	14.0
U.S. savings bonds	3.9
Investments in cooperatives	8.6
Total assets	383.5
CLAIMS:	
Liabilities:	
Real estate debt	34.5
Non-real estate debt	39.1
Total liabilities	73.6
Total	383.5

Source: [5].

deducted as business expense (e.g., meals served by airlines).

For example, the farm value of food included in the marketing bill in 1972 was $38.7 billion compared to total farm cash receipts of $61.0 billion. Processing and distribution costs added an additional $78.4 billion resulting in ERS's estimate of $117.1 billion consumer expenditure for domestic farm produced foods. Of this total, $103.0 billion is covered in the personal consumption expenditures for food estimated by BEA.

Table 3. Components of the marketing bill, 1972[a]

Item	Billion dollars
Labor	37.6
Packaging materials	9.4
Rail and truck transportation	6.1
Corporate profits	3.5
Indirect business taxes	3.2
Depreciation	2.8
Rent	2.5
Advertising	2.2
Repairs, bad debts, contributions	1.7
Interest	1.2
Other	8.2
Total	78.4

Source: [3].

[a] The marketing bill has recently been disaggregated from seven to 15 product groups. Similarly, information is available for four marketing agency groups and both at home and away-from-home consumption. See the August 1974 issue of the *Marketing and Transportation Situation.*

The basic farmer orientation throughout the history of the USDA is reflected in the marketing bill. Every component of the marketing bill is portrayed as a cost which is passed along to the consumer. This might leave the implication that the processing and distribution sector is "nonproductive." This also makes it relatively easy to direct consumer concerns toward agribusiness.

A recent study showed that in 1972 income originating in marketing farm food products totaled $42 billion, as viewed from a value added concept of the industry [6]. Labor income, which includes wages and salaries, fringe benefits, and imputed earnings of proprietors and unpaid family workers, constituted 80 percent of this total. Labor in food processing activities must add some utility to farm originated food products. Yet the income of farmers is portrayed in a favorable light while the income of workers in food processing firms and corporate profits are mixed in along with packaging materials in the marketing bill. If farm income increases, many "rejoice," for farmers represent the epitome of American free enterprise. Let corporate profits, labor, or other costs in food processing, marketing and distribution increase, however, and an air of exorcism invades the premises.

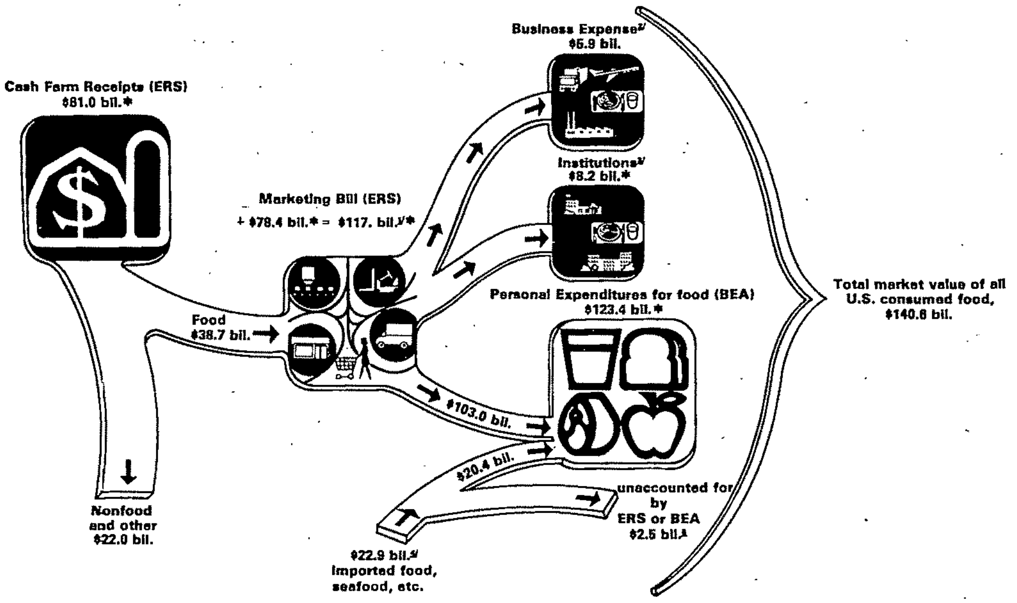
Thus we have captured in our national accounts for agriculture all the views and beliefs that we agricultural economists have had passed to us from succeeding generations. Could there possibly be an alternative view? To this task we now turn.

Alternative Concept of the Food and Fiber Sector

A broader view of the food and fiber system is needed which accommodates two factors. First, the view should recognize that profits and wages from the farm business are but one source of income to farm people. At the same time, not all the income generated by farming goes to farm operators, but also to partners, nonfarm landlords, farm laborers, farm corporations, integrated corporations, debt holders, and other nonfarm investors. Second, the view should recognize that the processing and distribution sector are integral parts of the food and fiber system and not an unruly stepchild which needs special monitoring.

Figure 2

LINKAGES BETWEEN CASH FARM RECEIPTS FROM MARKETINGS, MARKETING BILL, AND PERSONAL EXPENDITURES FOR FOOD, 1972



[1] ERS estimate of consumer expenditure for domestic farm food products bought by civilians.

[2] Food served by businesses and transportation expense. This is included in ERS consumer expenditure for domestic farm foods but excluded from BEA personal expenditure for food.

[3] Food served in institutions (e.g. hospitals, schools). This is included in ERS consumer expenditures for domestic farm foods but excluded from BEA personal expenditure for food.

[4] Value of imported foods, seafoods, other foods not produced on farms, alcoholic beverages, food consumed on farms where produced, and food furnished members of armed services. Partially included in BEA personal expenditure for food but excluded from ERS consumer expenditure for domestic farm food.

[5] Value of imported food, etc., served by institutions, businesses and as transportation expense which are excluded both from BEA and ERS series.

*Published numbers. The remaining are estimates provided by Terry Crawford and Charles Handy, ERS.

Any basic accounting system needs a unit of account. The suggested system replaces the farm and the bill with two "new" concepts of the industry: the establishment and the product (Fig. 3).[6] Establishments would be the basic unit of account.[7] Firms would be composed of one or more establishments.

The establishment would then be classified by type based on the major activity performed. If farming was the major activity, the establishment could also be engaged in other food and fiber activities or in activities external to the food and fiber sector as minor or ancillary enterprises. The establishment concept would provide the basic building blocks for firm, industry, or line-of-business views of the sector which are particularly useful in examining the structure and performance of the food and fiber system.

For those interested in the supply of food and fiber products, the product concept would provide information on the output of commodities from both food and fiber and other establishments. Any commodity output from nonfarming establishments would be included in the accounts as ancillary activities of those establishments. Product output could be accounted for in aggregate or by separate commodity depending on need.

The establishment and product concept of agriculture are basically business oriented. They emphasize the performance of the industry and its role in the national economy. Such an orientation would deter the use of business information for drawing welfare implications of people involved in the sector. Thus, proper linkages could be developed between farming as a business, for example, and the welfare of farm people who

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[6] The establishment concept is new only to the farming sector. The establishment has long been the basic unit of account used in the BEA's National Income and Product Accounts. For a detailed description of classification see [7].

[7] An establishment is defined as an economic unit, generally at a single physical location, where business is conducted or where services or industrial operations are performed. Where distinct and separate economic activities are performed at a single physical location, each activity should be treated as a separate establishment wherever: (1) no one industry description in the classification includes such combined activities, (2) the employment in each such economic activity is significant, and (3) reports can be prepared on the number of employees, their wages and salaries, sales or receipts, and other establishment-type data.

Type of establishment and activity	Type of product	Food and fiber products	Other products
Farming establishments	Farming	Major activity	
	Agricultural inputs		
	Food and fiber processing		
	Food and fiber distribution		
	Other activities		
Agricultural input establishments	Farming		
	Agricultural inputs	Major activity	
	Food and fiber processing		
	Food and fiber distribution		
	Other activities		
Food and fiber processing establishments	Farming		
	Agricultural inputs		
	Food and fiber processing	Major activity	
	Food and fiber distribution		
	Other activities		
Food and fiber distribution establishments	Farming		
	Agricultural inputs		
	Food and fiber processing		
	Food and fiber distribution	Major activity	
	Other activities		
Other establishments	Farming		
	Agricultural inputs		
	Food and fiber processing		
	Food and fiber distribution		
	Other activities		Major activity

Establishment concept of the sector

Product concept of the sector

Figure 3. Establishment and product concept of the food and fiber sector

actually depend very strongly on nonfarm income for family living.

Alternative Accounting System

The alternative concepts of the food and fiber sector are not amenable to the present series. We suggest that a new set of economic accounts be developed for agriculture based on a value added system much like our current U. S. national income and product accounts and also the system suggested by FAO and the Inter-American Statistics Institute [10, 15].

The accounting system outlined below will represent that suggested for the entire food and fiber sector. Similar accounts could and will be developed for each subsector within agriculture, but the utility of such an exercise in this paper is marginal. We will present two flow accounts, current production and capital flows; and two stock accounts, a balance sheet and a capital stocks inventory. Recent efforts to develop flow-of-funds accounts for the farm sector are important but considered out of scope for this paper [8]. Similar developmental work should be continued in this area of research.

The current production account for the product concept portrayed in Table 4 shows total output of the sector on the credit side and intermediate products consumed and gross value added on the debit side. Total output is disaggregated into two basic categories. The first is items sold to other sectors and to final demand. The second category, own account uses, includes intermediate products produced and consumed within the sector (a balancing item would appear on the debit side of the account), personal consumption of unsold output (e.g., farm perquisites), fixed capital formation (e.g., homemade machinery and equipment), and change in inventories.

Intermediate products consumed on the debit side would show both own-account production and that purchased from outside sectors. Gross value added includes capital consumption, indirect business taxes, business transfers, and net value added. In net value added, employee compensation would include wages paid hired farmworkers and employees in processing and distribution activities, rental payments to nonsector owners of capital, interest payments to debt holders, corporate profits, and proprietor income or operator surplus.

Table 4. Current production account for the food and fiber system based on the product concept

I. Intermediate products consumed	III. Items sold (by sector of purchaser)
A. Own account production	IV. Own account (unsold) uses
B. Purchased inputs	A. Intermediate products consumed
II. Gross value added	B. Personal consumption
A. Capital consumption	C. Fixed capital formation
B. Indirect business taxes	D. Changes in inventories
C. Business transfers	
D. Net value added	
1. Employee compensation	
2. Rental payments	
3. Interest payments	
4. Corporate profits	
5. Operator's surplus	
Total inputs	Total outputs

The current production account for the establishment concept is portrayed in Table 5. The basic difference between the two accounts is the inclusion of ancillary products and services produced on agricultural establishments and the exclusion of food and fiber output of nonagricultural establishments.

The physical capital stocks account, product concept, shown in Table 6 is more an inventory than a true account. All the stocks shown in the account will also be addressed in the section on the balance sheet developed below. The primary purpose of the account is to show the size of the agricultural "plant." Given information on total output, one can then address the issue of capacity, a subject of increasing interest over the last year or so.

The fixed capital items on the debit side are familiar to most economists. Inventory items are self-explanatory with the exception of work-in-progress. Here we refer to goods intended for final sales which are only partially produced. For example, cattle on feed are not considered finished goods but work-in-progress. The credit side of the account shows the distribution of physical capital by ownership. Other distributions could well be considered for the credit side of the account.

The capital stocks inventory, establishment concept, shown in Table 7 differs only slightly from that of the product concept. Capital stocks used in the production of ancillary products and services on agricultural establishments are included. Those capital items used to produce characteristic agricultural products on nonagricultural establishments are excluded from the account.

The capital flows account, product concept, is used to link capital formation activities portrayed in the production account with changes in capital stocks (Table 8). Fixed capital consumption which appears on the credit side of the capital flows account reflects capital stock used during the current production period as reflected on the

Table 5. Current production account for the food and fiber system based on the establishment concept

I. Intermediate products consumed	III. Items sold
A. For production of major activity products	A. Major activity products
B. For production of ancillary products	B. Ancillary products and services
II. Gross value added	IV. Own account (unsold) uses
A. Capital consumption	A. Major activity products
B. Indirect business taxes	B. Ancillary products and services
C. Business transfer payment	
D. Net value added	
1. Employee compensation	
2. Rental payments	
3. Interest payments	
4. Corporate profits	
5. Operator's surplus	
Total inputs	Total outputs

Table 6. Capital stocks inventory for the food and fiber system based on the product concept

- I. Fixed capital
  - A. Land and buildings
  - B. Purchased capital items
  - C. Formed on own account
- II. Inventories
  - A. Finished goods
  - B. Purchased materials
  - C. Work-in-progress

Total capital stocks

- III. Ownership
  - A. Proprietorships
  - B. Partnerships
  - C. Corporations
  - D. Cooperatives and other sectors (such as government)

Capital stocks by ownership

debit side of the production account. Any direct sales of capital items and inventories are also recorded on the credit side of the capital flows account to give gross capital disappearance.

Four items constitute fixed capital formation on the debit side. Own-account production, a credit item on the production account, and direct capital purchases from outside sectors are familiar at this point. Valuation adjustment captures the appreciation in the value of physical assets in the accounting period. The item is included here to emphasize its importance in explaining the changes in the market value of capital stocks more than a true capital formation activity. The item of primary concern is land which constitutes the largest single asset in the farming subsector. Additions to inventories are included on the debit side. Net capital disappearance is a balancing item in the account suggesting that the sector is either increasing or reducing the capacity of the plant. Thus, fixed capital formation, inventory additions, and net capital disappearance constitute gross capital formation.

The capital flows account, establishment concept, differs only slightly from the product concept counterpart (Table 9). Ancillary activities of food and fiber establishments are included in the account, and food and fiber output of nonagricultural establishments are excluded.

A balance sheet, establishment concept, presents both physical and financial capital controlled by agricultural establishments on the debit side (Table 10). Claims, both debt and equity, against these assets are presented on the credit side of the account. Because financial assets are rather difficult to identify on a product concept, a balance sheet product concept would not be unlike the capital stocks account, except having claims on the credit side.

The accounts developed above represent the basic business accounts for the food and fiber sector. They reflect the size of the sector, its output, structure, and control. But information is still needed on the income of farm operator families, hired farm laborers, laborers in processing plants, and other participants in the sector. To accomplish this, a personal income and outlay account could be developed for each target group (Table 11). Income received from food and fiber establishments (e.g., proprietary income, and wages and salaries) could be transferred to the appropriate personal income and

Table 7. Capital stocks inventory for the food and fiber system based on the establishment concept

- I. Fixed capital
  - A. Major product activity
  - B. Ancillary product activity
- II. Inventories
  - A. Finished goods
    - 1. Major products
    - 2. Ancillary products
  - B. Purchased inputs
  - C. Work-in-progress
    - 1. Major products
    - 2. Ancillary products

Total capital stocks

- III. Ownership
  - A. Proprietorship
  - B. Partnerships
  - C. Corporations
  - D. Cooperatives and other sectors (such as government)

Capital stocks by ownership

Table 8. Capital flows account for the food and fiber system based on the product concept

I. Fixed capital formation	V. Fixed capital consumption
A. Own-account production	VI. Sales of capital items
B. Capital purchases	
II. Valuation adjustments	VII. Disappearance of inventories
III. Additions to inventories	
A. Finished goods	
B. Purchased materials	
C. Work-in-progress	
IV. Net capital disappearance (Balancing item)	
Gross formation	Gross disappearance

outlay account where the income from all other sources would be added to obtain total income of the group. Income could then be allocated between personal taxes, savings, and personal consumption.

Concluding Comments

The alternative concepts and accounting system proposed above have several advantages. They provide an indication of the total output of the food and fiber sector—both that which reaches final demand and that which is used for intermediate product purposes. The system is consistent across all subsectors within the food and fiber sector—all rely on the same basic unit of measurement. It can better reflect the economic interaction of the sector with external sectors. A value added system gives a more realistic picture of the viability of the agricultural plant from a business perspective. Finally, the system also provides a measure of the personal income of sector participants.

Income generated by the agricultural sector in the United States is currently under-identified. This is due basically to the concept that is portrayed for the industry. Many others besides the farm operator receive income from the economic activity of farming. The total labor and capital commitment to agriculture is much larger than portrayed by the national family farm in our present accounting framework.

Some may view this paper as an obituary for the family farm. The family farm is still a strong viable concept if it is equated with a proprietary business—a family controlled proprietary business. The establishment view of the agricultural industry can accommodate the concept of a family controlled proprietary business. But the family farm of 1974 is much less of a social institution than the family farm of 1940. Most businessmen will concede that mixing nostalgia with business practices can have dire consequences. The time has come to separate the view of farming as a business activity from that of farming as a way of life.

Although the proposed accounting system described above is rather straightforward, implementing the system is quite another matter. Although many of the elements could be estimated with available data, considerable information is needed before many of the elements can be completed. Even our current data are not

Table 9. Capital flows account for the food and fiber sector based on the establishment concept

I. Fixed capital formation	V. Fixed capital consumption
A. For major product activity	A. Major product output
B. For ancillary product activity	B. Ancillary product output
II. Valuation adjustments	VI. Sales of capital items
III. Additions to inventories	A. From major products enterprise
A. Of major product output	B. From ancillary products enterprise
B. Ancillary products	VII. Disappearance of inventories
IV. Net capital disappearance (Balancing item)	A. On major product account
A. Major product enterprise	B. On ancillary product account
B. Ancillary product enterprise	
Gross capital formation	Gross capital disappearance

Table 10. Establishment concept balance sheet for the food and fiber system

I. Physical assets	III. Debit claims
A. Fixed capital	IV. Equity claims
B. Inventories	
II. Financial assets	
Total assets	Total claims

conceptually consistent in themselves and with the proposed new concepts. For example, current gross receipts reported in the *Farm Income Situation* are estimated from product data, thus more consistent with the product concept. There is less certainty on production expenses where the estimates are suspected of being closer to an establishment basis. Thus realized net farm income is not completely an establishment income estimate although it is portrayed as such. The marketing bill, on the other hand, is estimated from benchmark establishment data. Even many of the components of farm production expenses and the marketing bill are not conceptually consistent with one another. For example, depreciation is estimated on a replacement cost basis in farm production expenses but is based on book value in the marketing bill. These differences must be rectified before the above system can be instigated.

The national family farm and the marketing bill are useful concepts and provide the basis for series which answer many questions asked of the agricultural establishment. Efforts to update and improve these series should continue as long as demand persists. However, they do not give an accurate picture of the role of the food and fiber sector in our national economy nor its size, structure, and performance. These are the questions increasingly being asked today. The above ideas represent but a rough preliminary outline for building a data system designed to answer such questions. This challenge we lay before the agricultural economics profession.

Table 11. Personal income and outlay account for each target group

I. Personal taxes	IV. Operating surplus from food and fiber establishments (proprietary income)
II. Savings	V. Operating surplus from other establishments (proprietary income)
III. Personal consumption	VI. Wages and salaries (employee compensation)
	VII. Rental income
	VIII. Interest and dividends
	IX. Social security benefits
	X. Other income transfers
Total outlay	Total income

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Monitoring the Agricultural Economy: Strains on the Data System*

ELDON E. WEEKS, GERALD E. SCHLUTER, AND LELAND W. SOUTHARD

ONE CAN EASILY infer from the preceding paper by Carlin and Handy that its authors think there should be sector accounts for the food and fiber system. The accounts should cover sufficient "scope" of sector activity to provide a perspective within which a large number of issues may be examined. The accounts should be formatted to facilitate intersectoral and international comparisons,[1] and analysis of such issues as factor roles and shares, structure, interindustry dependencies, economic well-being of participants, industry capacity and utilization, and industry productivity.

This discussion adopts the same definition of the food and fiber system that was used in the preceding paper. The system is composed of farming, marketing, and direct input supplying subsectors.

Nature and Purposes of Economic Accounts for the Food and Fiber System

"Basic" economic accounts for the food and fiber system should be designed to provide a comprehensive picture of the economic situation by recording and presenting an interrelated structure of economic stocks and flows of a nation's food and fiber economy in terms of aggregate value statistics. Other related and supplementary statistical information such as quantities, prices, and population should also be provided systematically in supporting tables.

Perhaps the most efficient way to present such aggregate information is in a system of accounts for the entire economy of a nation [5]. Food and fiber system economic accounts, therefore, should amplify and be consistent with the general national accounts. It cannot be too strongly emphasized that economic accounts for the food and fiber system have important roles to play in providing statistical information of a nature which can only become available when a sector of an economy is singled out and presented in a systematic way. National accounts loaded with such sector detail would require unmanageable sets of tables, thereby losing their distinctive role of presenting systematic overall information compactly.

Uses of food and fiber system accounts

There are, perhaps, two general kinds of uses for food and fiber system accounts which should be stressed. One is to show the size of the system and its contributions as a locus for national tangible wealth and as a contributor to national product and income. The other is to provide insight into the structure and situation of the food and fiber economy.

Sector size.—Although the general national accounts include national product by industrial origin, the specific subsectors are not consistent with the designation of an operating food and fiber system. Consequently, the role of food and fiber system accounts is one of identifying, highlighting, and making better estimates for the appropriate subsectors for such measures as total outputs, intermediate products consumed, value added, and stocks of fixed factors.

Why should we be interested in better estimates of the size of the food and fiber system and its component sectors? These measures and their major components provide unambiguous and directly interpretable monitors of change in the same terms that change is being observed in other sectors. Also, they provide for a control-total type of discipline, thereby reducing inclinations to "net out" items appearing otherwise on both sides of the same account. Thus they introduce greater perspective for detecting structural changes that would otherwise simply be reflected as changes in the aggregates. Here we are referring to structural changes of the type that can be illustrated by increases in sales of hay which may result from either increases in hay production or

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* Views expressed are those of the authors and do not necessarily represent those of the U. S. Department of Agriculture.

[1] To facilitate international comparisons of output, input, productivity, and the like, there is considerable effort being exerted toward the end of improving country statistics in general and agricultural statistics in particular, in properties and formats so that worldwide and regional situations can be identified and appraised. See, for example, [5, pp. 1–3].

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increases in farm specialization. Perhaps even more importantly, major sub-aggregate series are instrumental for accurate estimation of such sector-wide performance related measures as productivity, level of capacity utilization, rate of return, and the like. These measures, in addition to their direct use for current evaluation of performance, are important for planning related to economic stability and development.

Sector structure.—Showing the magnitude of the food and fiber system in the national economy is one use of the national accounts. Perhaps it is even more important to see how these contributions by the food and fiber system are made possible by the important mechanism of economic flows within and among sectors. These can best be elucidated by seeing how, in the simplest format possible, production in the food and fiber system and its component sectors is carried out by use of intermediate consumption and primary factors to produce goods and services [5].

A current production account, which measures in value terms the total inputs used on one side and the corresponding total outputs on the other, is the recommended presentation of production on an aggregate basis for the food and fiber system and its component sectors. The information must be well classified with respect to components of both inputs and outputs. Classifying inputs into intermediate consumption and primary factors is essential and, preferably, intermediate products and services consumed should be further classified on the basis of sector or origin. Similarly, the outputs should be classified into finished product and work in progress, preferably with both further divided into major commodity groups. What is really needed in the presentation of such accounts is a desirable balance between data presented in a compact form and in different degrees of detail.

Beyond simply monitoring the size of the capital stock in the various sector components of the food and fiber system, different types of capital formation and disposition should be enumerated by type of capital goods. Monitoring capital flows is especially important in the farming sector, first because part of the capital goods are produced and used on farms, and second because there is continuing need to enhance productivity through technological progress. Both size of the capital stock and its distribution by kind are intimately related, also, to broad questions of markets for current output, requirements for maintenance of capital stocks, factor productivity, and the attribution of joint and common costs encountered in estimating shares of costs and profits from the distribution of products of special interest.

The owners of primary factors employed in food and fiber production receive value added in return for their factor commitment. The owners of primary factors are households, corporations, or other institutions. An income and outlay account for any defined group of sector-participant institutions can be designed to show the sources, shares, and disposition of incomes accruing to that group of sector participants. The establishment of income and outlay accounts for categories of sector participants reflects specific income roles the sector plays for those who commit factors. Yet the maintenance of such accounts permits sharpened distinctions between sector production activity of persons and institutions and the sector's roles in the acquisition and disposition of household income. The anatomy of the relationships is made more apparent by the presentation format. Data contained in these accounts would be necessary for the examination of issues of well-being and equity involving actor roles and factor commitment levels in the food and fiber system. And they would relate to occupational or investor classes much as the establishments with which they are associated are related to industries as classified in the Standard Industrial Classification System, rather than pertaining to actors on the basis of residence as is now the case with the farm population.

Other desirable sector account characteristics

There is a whole set of issues related to industry structure, conduct, and performance [7]. If we can agree that an appropriate set of sector accounts should monitor important aggregates such as total output flows, stocks and flows of inputs, flows of factor shares, and the contributions of sector activity to actor income levels, then perhaps we can also agree that it is important to provide flexibility in the monitoring system. This means that we should, if the appropriate data are acquired for the proper units of observation, be able to present the aggregates broken out by any desired industry structural characteristic such as size of firm, size of establishment, ownership of assets, sub-type of establishment, or geographic region.

Recognizing that future needs for data will be unpredictable reinforces the notion that the presentation format for important sector aggregates should be as compact and easily understood as possible. The aggregates themselves should have enduring meaning for direct intersectoral and international comparisons. The interrelated set of aggregates and the formats used to present them should allow for almost any kind of data disaggregation to reflect important structural and institutional characteristics of sectors and industries.

Carlin and Handy, validly for their purposes, discuss establishment and commodity concepts of industry [2]. They also note that the prevailing present concept of industry for farm sector aggregates is the National Farm. In our opinion the farm may be viewed as a special case of an establishment in order to capture nearly all the production of characteristic farm products within the farming sector. Alternatively, we may view industry as composed of firms whose major outputs are the goods and services which characterize the designated industry. If we are going to pursue our interests in issues of asset ownership and control, our interests are often in the sense of the relationships between firms on the one hand and related quantities of specific commodities on the other. Thus current issues may take us into analyses involving more than one view of industry.

Another dimension of desired flexibility is a capability to monitor commodity flows (both quantities and values) across sectors and industries, and to identify the costs and returns flowing in the reverse direction. Given the nature of industries in the food and fiber system, the flow monitoring for an individual commodity frequently means following flows "across the grain" relative to industry activities. This calls for an ability to detect product transformation coefficients. An understanding of the structure of intermediate consumption and primary factor commitments with related earnings shares is facilitated by using common concepts and terms among sectors.

In summary we should recognize that we will probably be faced with the need to reconcile different concepts of industry if we are to be able to relate to each other such issues as asset ownership and control on the one hand and commodity supply and disposition on the other.

Existing Monitors of Sector Aggregates

Carlin and Handy noted that the principal existing monitors of sector agregates are specially defined ones. They are *Farm Income, Balance Sheet of the Farming Sector,* and the *Marketing Bill.* Literature on their definitions, content, and shortcomings is abundant and it would take too much time to give that literature a rigorous review at this point [1, 8, 10, 11, 13, 15, 16, 17, 18]. Nevertheless, some characterizations are necessary in order to relate these measures to strains on the data system.

To some considerable extent, these aggregates were constructed to meet special information needs related to shares, equity, and industry viability. Consequently their development did not begin from a common, overall frame of reference with a consistent set of operational definitions and concepts involved in sector total factor use, intermediate consumption and outputs. Thus these measures are difficult to reconcile with each other. Each is a legitimate but specially defined measure.

The realized net farm income measure, in particular, is susceptible to change as a result of redefining institutions and populations. This is partly due to the historic associations between small proprietorships and farming activities. Obsolescence occurs when institutional changes or farm business practices render such assumptions and concepts at least partially invalid. This is particularly the case when both the conceptual outlines and much of the data are rooted in special issues of times past. There has never been any pretension that the net farm income measure was derived from measures of total outputs and total inputs for the farming sector.

The balance sheet of the farming sector was initially designed to measure the financial viability of farming operations. It has never been oriented specifically toward measuring the formation and disposition of farm capital and has always included both sector and personal account items. There is the emerging question of whether greater emphasis should be placed on measuring capital stocks for the farming sector and then present these capital stocks as elements of balance sheets for sector decision making institutions. As it is now, the balance sheet reflects a sector composed entirely of proprietorships and still focuses on a combined view of financial viability for both the farmer and his sector activities.

The marketing bill was initially designed as a measure of the difference between farm value and U. S. civilian consumer expenditures for domestically produced farm food products. It is an attempt, then, to show both farm and marketing shares of receipts for domestic consumer expenditures for domestically produced farm food products. Thus fish, shellfish, and imported foodstuffs are omitted, as are domestic farm foodstuffs produced for export and for military consumption. The marketing bill is an aggregation over a large number of industries as industries are defined in the Standard Industrial Classification Manual. Most disaggregations are, in fact, made to functions rather than to industries.

There are no existing aggregate monitors for the input subsector similar to those for the farming and product marketing subsectors.

Strains on the Data System

Generic strains

Carlin and Handy presented a set of possible economic accounts which, if implemented, would add to our present ability to monitor the performance of the food and fiber sector and both provide and require a more completely organized data base for economic research and analysis in this sector. However, borrowing an analogy from the marketing arena, when designing a new container, one should consider, in addition to the neat appearance of the container, the stresses this container will be subject to in use. Thus it is well that we review the strains which would be put on any data system for the food and fiber system.

If we polled each member of AAEA on the adequacy of the present data base for analysis in his particular field of interest, the resulting list of inadequacies would be large. This type of detailed listing will be avoided by discussing three broad types of strains: those related to interdependencies, to access to data, and to the resource commitment to the data base.

Any attempt to respond to the present strains on the data system with the provision of new information will inevitably affect the power sets of various actors in the food and fiber system. The provision of information is an activity which makes some decisions more likely and others less likely than would be expected in its absence. Through impact on the social decision process or through increased ability to choose, the beneficiaries of information can more likely make institutional changes to their benefit. Conversely, the power to choose could be decreased if others are benefited relatively more, or if the information makes institutional change to their detriment more likely. The authors acknowledge the importance of this role of information, but discussion of the distributional impact of any modifications of the data system is beyond the scope of this paper.[2]

The first strains to be discussed are those introduced by interdependencies. Reams have been written about the trend towards specialization in almost all parts of the food and fiber system. Specialization and interdependence of the components of the system go hand in hand, creating situations where an individual actor is highly dependent upon the other actors and vulnerable to changes in other components of the system. This results in a proliferation of demands by individual actors for information about the rest of the system as a means of obtaining some degree of control over their vulnerability.

Since participants in the rest of the economy may place different emphases on issues, consideration of the interdependence between the food and fiber system and the rest of the private economy introduces a new type, as well as level, of demands for information. These, added to information demands for public policy decisions, create potential total demands for information about the food and fiber system that may well approach insatiability. This pattern of proliferating demands for data is a logical development of an increasingly complex society.

An ideal data system should service the maintenance of a relevant data base with periodic survey supplementation for additional and specific problems [14]. The question faced by the data manager is how best to modify the various sources of data to obtain and maintain completeness and relevancy in the data base. A data base that adequately services such an interrelated sector as just described is obviously very interrelated itself, and any proposed modification may indeed be a very complicated venture. Much care must be exercised that a related section of the data base is not compromised more than the benefits expected from the initial modifications to the system.

One additional strain on a data system as industries institutionalize closer coordination is that the accompanying product flows may result in fewer public market transactions and thus less information for other interested actors in the system who were not part of the transaction. This brings us to the second general area of strains, access to data.

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[2] The reader is referred to [9, pp. 227–234], for an excellent discussion of the issues raised for economists by this role of information.

One of the more valuable uses for data is to serve various kinds of decision making. Data are information. Only when they are ordered and analyzed do they become economic intelligence and useful to decision makers. Some types of decisions will likely have to be made with or without such information. Thus, simply put, the decision maker must have access to the data in the form desired and by the time he is to make the decision if data are to have greatest value. This is a payoff for the maintenance of a data system. Many problems are involved in the process of reaching this point. First, the data collector must have access to base information relating to either or both subject and pertinent units of observation. This is no small problem with data from larger firms and certain types of financial, conduct, and performance types of information.

Second, the data provided must meet the occasionally conflicting conditions of relevancy, accuracy, and timeliness. Relevancy, having the appropriate information by the time a decision must be made, can strain the data system by demanding data in an embryonic stage or with different conceptual properties than those contained within the system. Since it is virtually impossible to avoid errors of measurement completely, it is hard to conceive of absolute accuracy. Beyond these direct errors of measurement, additional errors may occur in compiling selected aggregates. Almost any complex statistical series will reflect judgments required to make the series representative of those characteristics which it attempts to measure [4, pp. 1–3].

Timeliness of data is especially critical when so much of our work is concerned with projecting and forecasting. Many data users claim they prefer preliminary data labeled as such to no data at all. However, this charitability often fades when subsequent information results in a substantial change in the preliminary estimate.

A third, yet essential point, is that the decision maker or data users should be aware of the existing data series. An alarming number of members of our profession have a knowledge of the existing data series limited to those published in *Agricultural Statistics*, which represent the core but certainly do not contain all the relevant data for analysis of the food and fiber sector. This is difficult to explain under the condition of demands for data far in excess of the available supply.

The final generic strain we wish to discuss is the commitment of resources to data collection and data system maintenance. After the characteristics of an optimal data system are delineated and potentially effective means of obtaining the required data are developed, inadequate funding would be a severe strain—particularly if these levels are below those required to support a critical mass of data and research personnel to develop, implement, and maintain basic series with properties consistent with various further uses.

Specific strains encountered now

In the current agricultural data system, there appear to be at least four major types of strains: (1) lack of public data; (2) lack of data in a form that is readily usable by our current data system from both secondary and primary sources; (3) changing time frames; and (4) the fitting of the agricultural data system components into the broader and expanding federal data systems.

While monitoring the agricultural economy with the present data system, we have found many gaps in the public data system relevant to important current issues. For example, ERS was given a Congressional mandate to break out cost components of the margins of selected food items [12]. A search of available data revealed that only bits and pieces of the necessary information existed from secondary sources. To fill in the gaps, ERS contracted with two universities and a private source to develop the methodology and the necessary data. One phase of this research is reported in another paper given at these meetings [3]. However, for many questions of public interest that are raised, we find that appropriate properties are not present in data readily available from private sources. Similarly, there is a great reluctance on the part of many respondents to furnish the same data items to public agencies although the information is to be made available only in aggregate form.

Closely related to lack of data is the problem of data in a form that cannot be used consistently in the current data system. Many times in researching a problem we have to make do with less than ideal data. In cost surveys we find many firms have set their accounting system to minimize the income tax paid when we as economists would prefer to have the "true" costs. In making our agricultural data system operational, we often find that we have to "make do" with existing statistical series that were not designed for our use and may have to compromise intended concepts somewhat. In the marketing bill work, for example, the labor cost component is estimated from data from the separate Censuses of Manufacturers and Business which are on an establishment basis, and the depreciation cost component is estimated from Statistics of Income which reports data on a firm basis for tax purposes.

The volatility of prices and interest rates has recently introduced another strain on our agricultural data system, that of changing time frames. Before the recent volatility of prices, periodic annual and quarterly data were considered adequate. Now we are faced with providing quarterly, monthly, and sometimes weekly data instead. Two obvious possible approaches to the problem are to raise the frequency of surveys or to continue to make estimates based on existing data flows. However, using data as now gathered by other agencies presents a problem of timeliness with respect to current demands for information. When they are obtained from someone else, there must be turnaround time if the estimate is to remain timely.

The other strain of our present agricultural data system is of a legal type. Every agency of the federal government that collects and publishes statistics must conform to certain legal conditions as prescribed in their statutory and budgetary authority and in the federal information acts. In the statutory and budgetary authority, agencies are required to collect and publish statistics for certain specific purposes. In some instances an agency may be responsible for expanding a component of a broader statistical series of another agency. For example, the retail cost of the market basket for U. S. farm produced food published by ERS is actually a specially defined component of the CPI that is published by the Bureau of Labor Statistics. Within the broader federal data system, there are many other interrelationships between the agricultural data system and the data system in other executive departments. The Office of Management and Budget has overall control and coordination of the different data systems within the federal government to avoid duplication of effort and to interpret statutory authority. The primary data gathering agencies, such as SRS and Bureau of Census, are obligated to expend principal effort on mandated missions. Many of the features of industry aggregate accounting measures must rely on "piggy-backing" their data needs on these missions. In addition administrative data are often either confidential or lack properties consistent with those already embodied in ongoing accounting measures.

From present sector aggregates to economic accounts—expected additional strains

Our present data system has evolved from combinations of issues and resource commitments of the past. Many of the pressures and issues have survived with only changes in priority. Some have left, new ones have emerged. Thus the process of evolution continues to lead data system development. We now address ourselves to the pressures which we could expect to be exerted on the system by an extension of present measures to a set of sector economic accounts.

Semantics can be a severe strain. Problems of defining difficult concepts increase the likelihood of misrepresentation and mismeasurement.[3] The implementation of a set of sector accounts would introduce a number of new concepts. One need only reflect on the difficulty of arriving at a consensus definition of a farm to visualize the strains in arriving at operational definitions to implement measurement of the concepts presented by Carlin and Handy.

The importance of retaining a flexibility to reflect change and still preserve the basic conceptual properties of sector aggregate measures is illustrated by recent experience in the farm income accounts with farmers' expenditures for custom work. When the accounts were established, the primary interest was in estimating the net farm income of farm operators. Since most custom work was assumed done by farmers for other farmers, these transactions would net out in the accounts and were not included as receipts and farm production expenditures. By the time the emergence of a viable custom farm service operation was perceived and data collected to include these expenditures in the accounts, the magnitude of farmers' net expenditures for such services was nearly a billion dollars.

The implementation of a complete set of economic accounts may require more detailed information than is presently available. A data system which must service both a commodity and an establishment view of an industry must allow for the differentiation between primary and ancillary outputs of the producing units as well as the associated fixed and variable inputs for each type of output. This is especially necessary if there is to be consistency between commodity information systems and sector economic accounts. For example, all of the Economic Censuses would have to collect much more detailed costs, product flows, and related statistics to estimate all of the components of the marketing bill on consistent establishment and commodity bases.

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[3] For example, see [6, pp. 17–19] for a discussion of four concepts of value added.

Some of the information required to implement the proposed sector accounting system may be difficult to obtain. This difficulty arises from two sources, the reluctance and the inability of the respondent to supply the requested information. Examples of data which respondents are sometimes reluctant to supply are data on income, debt-status, or other information which may reveal market share or market strategies for firms. Respondents may not be able to supply valuations of assets and inventories because of incomplete records and lack of appropriate market prices. Other data requested may not be available from respondent records in the form or concept demanded by the data system. Some available data are not in present accounts because they are simply assumed to net out. The system outlined by Carlin and Handy would require estimation of values for all outputs and inputs.

Economists are often like hunters in constant search of elusive prey. Their prey is the ultimate stable relationship. Implementing a set of sector economic accounts would undoubtedly open a new round of searching. The data requirements for filling the cells in a sector accounting scheme may be great and possibly expensive to obtain on a frequent basis. However, if stable relationships can be identified between benchmark estimates and periodic correlates, the data can be maintained with a less elaborate data gathering system. The identification of these stable relationships and the optimal mix of data gathering resources between benchmark estimates and periodic movers would appear to be a researchable problem for examining specific aspects of a specific system.

Concluding Observations

We who work in the agricultural data system feel like the operators of a city street department told that a certain street is too small, dilapidated, and congested to accommodate the present traffic flow. The operators must keep the traffic flowing while a better street is designed and constructed. As many of you know, new road construction while maintaining traffic flow is not done easily or quickly.

The present data system was built up over a long period of time from concepts and data sources of an earlier era which were expanded as outstanding needs arose. There is no reason to believe that the system as it now exists should be scrapped and replaced. Perhaps the concepts and measures now provided will continue to be of value for a long time to come. Still, it is increasingly apparent that these concepts and the system used to quantify them fall considerably short of being sufficient for many of the questions we must try to answer and many of the comparisons we must make.

The present system can be used selectively as a take-off point for the implementation of additional and expanded measures such as the alternatives discussed by Carlin and Handy. A large, complex data system will always be strained when changes are made. Major additions to the concepts to be quantified by the system would require both new data and the stresses involved in trying to bend some of the old data to new uses.

We have discussed some of the likely sources of strain associated with reconciliation of various perspectives of the food and fiber industry; with generic roots in complexity, access to data, and resource commitment to the system; and with take-off points such as detailed commodity and cost information more amenable to aggregation procedures.

Before the subject implied by the title of this paper can be fully developed, certain other explorations must be developed and completed. There are other layers of operational definitions and concepts which should be explored thoroughly—depreciation, in-kind transfers, farm housing, and the like. An inventory of available data and their acquisition procedures should be made and examined. And an estimation, then, of remaining data requirements should be made based on what is available for doing specific jobs. Then the strains on the data system could be viewed from a more specific set of circumstances than were available to use for preparation of this discussion.

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Public Policy Demands and Statistical Measures of Agriculture

LEO V. MAYER AND J. DAWSON AHALT

INFORMATION, its generation, communication, and implementation has become the lifeblood of the highly-refined, market-oriented economy in which we live. The intelligence-generating sector has become the source through which that information is generated, evaluated, and communicated to a market of final users. Information, in this sense, is a commodity, subject to supply and demand conditions like any other commodity. The forces affecting these conditions are open to analytical effort as with any economic phenomenon. The focus of this paper is toward examining one particular part of the demand side of that market—public policymakers—and their particular needs for information.

Given an economy where information production and distribution was organized through an open market, a price system would pass signals between the suppliers of information and those demanding information. These signals would indicate, with varying degrees of accuracy, the amounts and types of information desired by different categories of users.

Under a system where these activities are generally organized and supported by the public sector, the quantity and nature of information supplied respond to nonprice indicators, often with considerable lag to changes in informational requirements. The lags show up in various forms: there is, for example, a strong tendency for the informational system to concentrate on known problems, rather than to anticipate potential problems. This arises because the system operates in an environment where the cost of misjudgment, in terms of future effectiveness, may be quite high. Consequently, the system tends to focus on past problems. There is, under these conditions, a continuous flow of information explaining past events. Where history repeats itself, that is, where economic cycles exist, such a system provides information for future decision making.[1]

An information crisis arises, however, when events occur that differ substantially from past behavior. Their explanation and understanding require the initiation of new areas of inquiry, a slow and costly process as demonstrated by the length of the Great Depression, the vast expenditures on the Manhattan Project of World War II, the space program of the last decade, or the solving of the inflation problem of the present decade.

Information for Public Policy

Our examination of the role of statistical measures of agriculture begins in a broad context because our experience in policymaking convinces us that the value of accurate measures of economic activity depends not only on their accuracy but also on their form, manner, and ease of communication to busy policymakers. We recognize that national policymakers are but one source of demand for information. Further, their demands for information do not differ necessarily in content but rather in the type, form, and quantity of information provided. That implies that statistical measures for policymaking must not only be accurate but also must be organized to meet the special requirements of policymaking.

Policymaking requires three extremely and equally important informational systems: (1) Statistical measures to provide an "early alert" system for problem identification. The system to be useful in policymaking must provide adequate time to allow the Government to organize its response to a particular problem. (2) Measures to provide adequate description of the problem to allow formulation of policy options. Unless the problem is adequately identified so that policy options can be developed, the whole process of data generation and interpretation

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[1] See [3]. This article exemplifies the usefulness of anticipating the impact of potential problems. Publication prior to devaluation of the dollar might have assisted in a more rapid understanding of the sharp run up in food prices of 1972 and 1973.

becomes a sterile exercise in futility. (3) Statistical measures that are communicated in a form to allow ready interpretation and understanding by busy policymakers and administrators who may handle the specific problem only once or perhaps only occasionally. Unless data and factual measures can be readily understood, there is a tendency to base decisions on preconceived notions or earlier experience in other sectors where the decision maker is more comfortable. Thus, beef price control programs may be based on the assumption that fed cattle move through feedlots like new cars off assembly lines, or soybean export embargoes are assumed to have the same impact on foreign and domestic markets as embargoes on scrap metal or lumber and hides, and pricing of agricultural products is assumed to occur like pricing of industrial products and thus may be subjected to the same control programs.

The "market" for statistical information formed by national policymakers is a different market, we are saying, not in desirable degrees of accuracy but in terms of its organization and presentation. Whether we like it or not, today's national policy "market" is not composed primarily of agriculturalists but rather of decision makers who may be unsure, for example, whether farmer intentions to increase hog farrowings mean more hogs for slaughter or more baby pigs for future expansion. Placed in a format more familiar to them, perhaps an "index" of expected hog production, related decisions on adequacy of feed supplies, export quantities, and grain plantings becomes more comprehendible.

This example is meant to overstress the new problems that occur when food policy becomes of such widespread importance to government that its formulation becomes a combined effort of several major agencies, many of whom do not have specialists in food policy. So long as food policy remains the pasture of former Land Grant University administrators or even former farm state governors, the specialized nature of its statistical measures is of little hindrance to rapid policy decisions. Also, as long as change in these measures is relatively modest so that decisions can be planned weeks in advance, peculiarities like carry-in, carry-out, and carry-over, or specialized terms like vealers, heifers, feeders, and stags do not pose communication barriers on decisions affecting national food supplies. But when these decisions must be made overnight and solutions are required within hours, the differentiation of agricultural data from other types becomes a constraint to swift and accurate action.

Even in the context of more normal conditions, the optimal organization of economic measures may change with changing market conditions. For example, as markets tighten and increase the substitutability of commodities (as general equilibrium theory specifies), measures of individual commodities may mislead in describing market conditions. Using data on corn instead of all feed grains, or wheat as opposed to food grains, or beef instead of red meat, may inadequately describe true supply and demand conditions. Moreover, focusing on individual commodity statistics may lead to inaccurate description of the actual market choices faced by consumers. In the past year a lack of appreciation of consumer substitution possibilities may have led to the decisions for keeping the price freeze on beef while removing it from pork and lamb, or to the placing of an embargo on soybeans but not on cottonseed, flax, peanuts, or other fats and oil products. Such decisions later required supplementary actions in an almost never ending process of correcting for having inadequately framed the scope of the problem, the descriptive statistical measures, and the option available to policymakers.

We are aware, of course, that aggregate agricultural statistics have a long history in the profession. These include prices received and paid indexes; farm income statistics; indexes of farm output, inputs, and agricultural productivity; and the market basket series to name a few. Of a lesser frame, but none the less useful, are the indexes of per capita food consumption; gross farm product; and the supply-utilization index. In addition there are many other dollar aggregates and indexes that are prepared regularly by various agencies within the U. S. Department of Agriculture as well as some of the Land Grant Universities and state agriculture departments either for publication or for internal use. Most of the series that we are familiar with provide useful functions and even play a role in helping formulate policy decisions. However, for the most part they do not provide the necessary coverage for a market oriented agriculture, or they are simply too untimely to be useful in current decision making.

One promising example of a comprehensive, easily understandable framework of aggregate agricultural activity probably lies in USDA's little known supply-utilization indexes. These measures combine annual agricultural commodity supply and use data into constant dollar value aggregates based on farm level prices.[2] The supply-utilization index contains the advantages of combining all commodities into a manageable aggregate, as well as specified subaggregates, while at the same time providing analysis of functional behavior (i.e., production, imports, and stock change). Moreover, because of the simplicity of the system, it is easily manageable for analytical purposes.[3]

Beyond meeting the needs of busy policymakers, these economic data systems appear to have substantial secondary benefits. In general, we agricultural economists spend little time communicating with our counterparts in the nonfarm sector. It would seem that work in the area of activity aggregates would stimulate efforts to link agricultural activity with the rest of the economy. A more easily understood macro system would seem especially helpful to analyzing price linkages—a much needed area of work in a period of strong inflation. Moreover, explorations into macro-agricultural accounts would facilitate the development of frameworks for appraising the relationships between agriculture, food, and energy, a situation now primarily limited to static input-output analysis.

Policy Changes and Statistical Measures

The implication of the argument to this point is that recent changes in policymaking and market conditions have altered the form if not the substance of the required statistical measures. Of course, an argument could be raised at this point that food decisions are of interest to the Departments of State, Treasury, Justice, Commerce, and Defense only during periods of food scarcity. Once these are gone, policy will again return to the halls of the Department of Agriculture. Further, an argument could be made that food policy is the appropriate activity of agriculturalists, its accurate development requiring a knowledge of the specialized nature of the economics of agricultural production. In this line of reasoning, statistical measures of agricultural output in their traditional form may tend to assure that control is retained over this important activity.

Each of these arguments has some merit and likely appeals to some groups. These are, however, only surface arguments. Decisions regarding agriculture are also of concern to other government agencies when farm prices are low. The Office of Management and Budget expresses much interest when low farm prices create a need for direct payments to farmers or when purchase and storage programs become necessary. Also, the United States has undergone several periods in the past three decades when food markets have tightened to a degree that food policy became a national issue as opposed to a sectoral issue. The probability is high that we will face similar periods in the future. The accuracy of decisions during such periods is dependent on accurate and understandable measures of activity in food production. Even the belief that the economics of agriculture differ substantially from the economics of other sectors has largely disappeared with the general elimination of agricultural fundamentalism in our scientific communities, the consolidation of graduate training programs for economists, and the formation of a consistent sequence of economic theory. Support for the arguments of keeping agricultural statistics in forms understandable only to agriculturalists largely disappears in the process.

There are other forces at work, however, that are more substantive and hence argue even more strongly for changing or at least adding other forms of published statistical measures of agriculture. Some of these changes have received widespread attention of the agricultural fraternity in recent years[4] as ongoing structural change in agriculture has resulted in intensive examination of data formulation to ensure that these measures reflect as accurately as possible actual shifts in agricultural production, marketing, and management. Improving statistical measures has been essential as the structure of the agricultural economy reshaped itself in terms of numbers of farms, farm operators, sizes of operations, and degrees of specialization. It now appears, however (using traditional measures), that the most rapid part of that restructuring is over although the industry will continue to change as the aging process releases the more tightly held resources to the forces of the marketplace, specialization continues to proceed in production areas so far only nominally affected, and the ripple effects of new technology continue to reshape the nonfarm portions of rural areas.

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[2] The system is used internally at USDA to cross-check related aggregates and is published regularly in the National Food Situation and Agricultural Statistics in index number form. The value aggregates (which are most useful for analytical purposes) are not published.

[3] For example, analysts are able to estimate aggregate supply-demand and price estimates and check these against the results of commodity aggregations. Unfortunately little effort for further refinement and development has gone into this system in recent years. This lack of attention primarily reflects the agricultural community desire for commodity detail as outlined earlier. However, if serious attention were to be devoted to time disaggregation (e.g., breaking the series into quarterly estimates) and in improving the price weighted conversions, this system would in our opinion go a long way in filling the gap for a much needed comprehensive short term measure of the agricultural sector. The possibilities of seasonal adjustment in this context are obvious (despite the distaste for this technique by many agricultural workers).

[4] See [1] for the concern expressed by the Economic Statistics Committee of the American Agricultural Economics Association.

The major portion of this change has occurred although the published statistics on the industry still largely reflect the former structure because of the definition of a farm. As an accurate accounting system on the number and classification of farms is developed, it is likely to change drastically the concepts of relative income standings of full-time farmers. It is likely true, for example, that publication of quarterly earning reports as published by the industrial sector would have caused agriculture as much consternation in 1973 as it did for petroleum companies in early 1974. This kind of public impact may well be the side effects of revising the system of statistical measures of agriculture to coordinate them more closely with nonfarm and modern accounting systems.

This kind of change will not, however, fulfill the need for a more aggregate system of data to measure the sectoral operation of agriculture. Just as the changing structure of agriculture implies changes in statistics, changes in agricultural markets and policies also create a need for revising the form of statistics for the use of national policymakers. Organizing statistics to reflect accurately the aggregate supply and demand conditions is essential if the market place is to establish equilibrium prices rapidly. It is also necessary if the consumer sector is to understand the market conditions it will face at the grocery counter.

The general focus of today's published statistics reflects two major facts. First, they were developed to assist agriculture in making decisions at the producer and commodity handler and processor level—that is, they were generally oriented toward micro decisions. Second, they were developed in a period when surplus production and marketing conditions led to the formulation of individual commodity programs to control production, and large amounts of information were required on the economic situation of each commodity. In turn our public system of generating information responded over time to this need.

The changes in both policy and marketing during the past decade have clearly moved policy decisions away from a commodity by commodity approach. Starting as far back as 1965, public farm programs were amended to allow for substitution between crops. This "loosening up" of control programs continued with the legislation passed in 1970 and again in 1973. Further, with the upward thrust of farm and food prices beginning in 1972, the market assumed much greater importance in allocation decisions. As support prices faded into the background, the secondary sectors of agriculture began to search for ways to hold down production costs, and consumers began a more intensive search for ways of holding down costs for foods. In general all these efforts increased the substitutability of inputs and final products and eliminated the individuality of inputs and commodities in price considerations.

Further, the determination to increase the market orientation of agricultural programs means there will be greater dependence in the future on interdependent market prices to allocate individual commodities. In essence, a major question then becomes whether measures of total production of all grains or of all oilseeds crops will be adequate to meet national and international needs. In turn, examining statistical measures of individual commodities becomes an inadequate means of determining supply and demand situations in agriculture. Even if the supply situation in agriculture were to cause a substantial return of over production, the importance of aggregate measures of commodities would still exist. The vast network of agricultural outlook information, policy formulation, and administration will necessarily have to reflect this new reality if it is to portray market conditions accurately to its customers. The statistical measures required to facilitate accurate and prompt market and policy movements will differ at least in form if not in substance from presently published statistics.

Reflections on an Information System

We began this inquiry with a review of the broad role of information in facilitating the functions of government policymaking. We close with some reflections on the economic conditions affecting the generation and implementation of information from the intelligence sector.

One characteristic of the economic environment of our information system is that it insulates those who provide information from those who use it. The system was organized in this manner for useful reasons. It does cause problems, however, when there are no hard signals to indicate directions for expanding or contracting production of information. In recent years we have seen a great proliferation of contract research which is one indication of the desire by demanders of information for a product different from that traditionally produced. Of course, the information sector is not alone in missing signals on demand for its products. The airlines with 747 Boeing jets parked in storage in Arizona and New Mexico and the auto manufacturing companies with stocks of the wrong sized cars have also misread trends in demand for their product. Even Playboy Enterprises apparently failed to carry out adequate market evaluation before purchasing Florida hotels and establishing playboy clubs. The market for these clubs is apparently among young, single age groups but mid-Florida vacationers were mostly middle-aged or older married couples. The result was empty hotel rooms that began to affect overall operation of the Playboy enterprises, most of which are incidentally engaged in providing the public with new and rewarding information of a statistical nature.

The Playboy example reminds one that simply providing a product or service is not adequate, no matter how valuable or necessary it is to the public. Of course most economists no longer accept the great Jean Batiste Say's celebrated theory of markets, "supply creates its own demand." Economists who followed Say found that not all markets expanded automatically to absorb new services or commodities. However, it sometimes appears that activities that generate statistical information operate on somewhat that same theory of markets. There is substantial and continuing concern expressed over the technology used to create the supply of information but only the most elementary thought given to the market for such information.[5]

In the beginning we referred to the three phases of a successful information system: generation, communication, and implementation of information. The third phase of the process is as essential as the first two, although it is often assumed that publication of information will have usefulness to some implementing group. One has only to pick up and read any one of the large number of publicly oriented academic publications to realize that information is directed to such general audiences as to lack use to any particular user. It is likely that a good portion of today's published information was aptly described by one agricultural economist who recently wrote in his review of a book that "it is another book by agricultural economists for agricultural economists." At one time that might have been a compliment; today it reflects the nepotistic nature of economic literature.

Perhaps we have gone far enough, or even too far in the minds of many, in commenting on the marketing aspects of information and economic indicators of agricultural activity. Generating statistical measures is a time consuming and largely thankless task. We are convinced, however, that what happens to these measures after their initial development is at least as important as their initial development. Truly we have an overload of information as a result of the modern day computers that is producing "brownouts" among users. The process of discriminating between useful and useless information is becoming more difficult, particularly under pressures like those that existed at a national policymaking level in the past two years. Improving on the substance of statistical measures is a justifiable goal, but there is more required than this one step if policymaking is to be improved.

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Session 5

MEASURING THE REALITY OF MODERN AGRICULTURE: NEW CONCEPTS AND STATISTICAL SYSTEMS

Discussants: C. Edward Budd, Pennsylvania State University; Karl A. Fox, Iowa State University; H. O. Hartley, Texas A&M University

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[5] See [2, p. 932].

INVITED ADDRESS

Food, Agriculture, and Rural Welfare: Domestic Policies in an Uncertain World*

WILLARD W. COCHRANE

AS THE TITLE suggests, this paper is concerned with the topics food, agriculture, and rural welfare and their interdependencies. It has become fashionable in recent years to discuss these topics in separate compartments, and for certain purposes such a separation can lead to productive results. But in seeking to focus on needed policy changes in the decade ahead for any one of these topics, I find that I am unable to do so constructively without at the same time dealing with the policy problems of the other two. Thus, in this paper I attempt to deal with the interacting problems of all three subject areas.

I

Let me turn first to certain assumptions that I make about the state of food and agriculture and the behavior of farm people. These are things that I know that I know, or believe that I know, about the subject of this paper and which serve as constants in the analysis.

1. Changes in the production of food and the availability of supplies in the world economy are unpredictable beyond the current crop year. Natural forces (e.g., changes in the weather) and national economic policies (e.g., changes in trade policy by a state-trading nation) make this so.

2. Grain producers of the United States are an integral part of the world market; the vehicles of commercial trade and food aid have made this so.

3. The aggregate world demand for grain is highly inelastic. Thus any small change in the world supply of grain sends relatively large price shocks throughout the world trading system, including the United States.

4. Neither farmers nor consumers are happy with extreme and unpredictable price fluctuations. Farmers may wish for constantly rising farm product prices, and consumers for constantly falling farm product prices. But neither wants, and both seek to avoid, price uncertainty and extreme price fluctuations.

5. Farm people want, as do their nonfarm neighbors, real incomes and real levels of living comparable to those of urban people, and they demand policy actions which will permit them to earn such incomes.

II

Next, let me discuss certain broad forces that are at work in world agriculture and in the socioeconomic systems of the U. S. The velocity and direction of these forces can and do change over time, again with important implications for policy. Since I am not omniscient, I cannot predict future changes in the velocity and direction of these forces with accuracy; I can simply describe them as I perceive them in 1974 and indicate how and where I think they are propelling us. To the extent that those of you in the audience perceive them differently than I do, the results of your policy analysis will differ from mine. Let us consider seven such forces.

1. *A clean, unpolluted environment.*—This force has been gathering momentum in the Western World for a decade. The Federal Environmental Pesticides Control Act of 1972 is a concrete manifestation of this force with respect to American agriculture. The current energy crisis has dealt the environmental movement a setback. But the goal of a clean, unpolluted environment has become an important force in the Western World that will be with us indefinitely and may become even more powerful once the initial shock of the energy shortage has worn off.

It has tremendous implications for agricultural production in the United States. In its mildest form it will spearhead drives to protect black-footed ferrets and coyotes, protect and clean up water supplies (both surface and underground), expand nonproductive open spaces, and reduce air and noise pollution; in its most extreme

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* The author benefited importantly from the suggestions and criticisms of his colleagues Martin Abel, James Houck, Lee Martin, Mary Ryan, and W. B. Sundquist in the preparation of this paper.

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form, it seeks a steady-state earth with zero rates of economic and population growth. Such actions will have the effect of reducing the usages of nondegradable chemicals in farm production, increase costs of transportation, increase the cost of farm technological advance, and in the zero rate of growth possibility, reduce the rate of growth in demand for farm products.

Simply stated, the drive to improve the quality of life (to achieve a cleaner, more attractive environment) in the industrialized nations of the West, as opposed to increasing the quantity of life (more goods and services), will have important implications for both producers and consumers of agricultural products.

2. *Energy usage.*—For 50 years or more we have been substituting cheap energy, embodied in efficient capital technologies, for expensive, inefficient labor and land. This process has resulted in great gains in productivity per acre, fantastic gains in productivity per farm worker, and except in certain emergencies (e.g., World War II, the past two years) caused output in the U. S. to expand more rapidly than demand. This has been a happy situation for consumers.

But every other sector in the U. S. has been using more energy too, and in the past two decades there has been a greatly increased usage of that cheap, easy-to-handle product, petroleum. Thus, within the past decade the consumption of petroleum in the U. S. has increased more rapidly than domestic production, and we have moved to an import basis. Experts differ with regard to the state of crude oil reserves in the world, but a projection of historical rates of growth in the consumption of petroleum will put a severe strain on, if not exhaust, those dwindling reserves over the next 30 to 40 years. Against this long-run prospect of petroleum shortages, the Persian Gulf cartel has through a series of monopolistic actions increased the price of crude oil three to four times over the past year.

Informed opinions vary as to whether crude oil prices and the prices of substitute sources of energy will rise, fall, or hold constant in the years immediately ahead. But events of the past year suggest to me that prices of gasoline, fertilizer, machines and equipment, and electric power will remain high in the years to come. And the long process of substituting cheap fossil fuel energy, particularly petroleum, for land and labor is going to be slowed down, hence gains in agricultural productivity from this source will be restricted. For how long, no one really knows, but certainly until technological developments provide us with a new source of cheap energy—perhaps from nuclear fusion, perhaps from solar sources. In my judgment this will be a matter of decades, not years.

3. *Farm production efficiency.*—Farm production efficiency increased persistently from 1950 to 1965. But since 1965 farm productivity has sputtered. Output per unit of input leveled off in the period 1967–70, shot upward in 1971, leveled off in 1972, and moved up again in 1973.

Predicting technological developments and their farm adoption is a risky business. But, from talking with agricultural scientists, I have discovered no great technological breakthroughs occurring on the international scene and no great technological development in the United States that now awaits farm adoption. There is much going on in the way of development and adoption, as we all know, but a technological advance on the order of hybrid corn does not appear to be "in the wings waiting to come on stage." It is my guess that farm technological advance and the resulting gains in productive efficiency will be halting and irregular during the coming decade.

4. *Farm population.*—The long decline in farm population in the U S. would seem to be coming to an end. The number of people living on farms has held almost constant since 1970; in fact, the number increased modestly in 1972 and 1973. Similarly, farm employment has held almost constant at 4.4 million since 1970.

This suggests to me that agriculture during the coming decade will no longer be a contracting industry in terms of employment opportunities and no longer a declining force culturally and politically in the national society. It may start developing as the classical economists argued that agriculture should develop—with increasing employment, increasing costs, and rising land rents.

5. *World population growth.*—The population of the world continues to grow at a frightening speed. At present rates of growth the population of the world is doubling every 30 to 40 years. As we know, the most rapid rates of population growth are occurring in the less developed countries where the people involved and the economic development processes involved can least afford such rates of growth.

To date, food production in the less developed world has, on the average, kept pace with or exceeded the rate of population growth. But I cannot be optimistic about the outcome of the long-run race between food production and population growth in the less developed world. Restrictions on land available for cultivation and supplies of water for irrigation, rising costs of energy and fertilizers, and rates of technological advance that are less spectacular than those associated with the Green Revolution of the late 1960s suggest to me that most LDC's will have great difficulty maintaining present rates of increase in agricultural production over the long run. If this is the case, then rates of population growth in those countries must come down; and they will come down either through purposive birth control actions or through the Malthusian controls of hunger, disease, and death. In the meantime, demands on the Western World to provide food aid to the less developed world will again become intense.

6. *The rising demand for meat in the developed world.*—Consumers in Japan, Western Europe, Eastern Europe, and the Soviet Union have experienced significant gains in real incomes in recent years. Given these income gains, those consumers want to do what American consumers have been doing, namely, eat more meat. And they are eating more meat. As a result, the demand for feed grains and oilseeds and oilseed products—the raw materials of meat production—emanating from these developed countries has increased steadily for a decade and increased spectacularly in the past two years. This strong demand for two of the leading export commodities of American agriculture, once thwarted by an overvalued currency and recently abetted by a devalued currency, was one, if not the leading, force in driving farm prices to record peacetime highs in 1973.

The demand for feed grains and oilseeds and oilseed products should continue to expand in the developed countries with their continued economic growth since the per capita consumption of meat in those countries is low when compared with the consumption of meat in the U. S. Can we, then, look forward to sustained economic growth in Japan, Western and Eastern Europe, and the Soviet Union, as well as certain of the more favored LDC's (e.g., Korea, Taiwan, Mexico)? Given the possibilities of war, energy crises, and runaway inflation, no man can say for certain, but on balance the economic future for much of the developed world looks strong and bright. This means that the world demand for animal products and feed grains and oilseeds should remain strong and the prices of those products buoyant.

7. *General price inflation.*—As we have noted, current and prospective energy shortages have caused the price of most nonfarm-produced inputs to rise, and social forces to improve the environment are likely to drive up the cost of producing food. But these have not been even minor contributing causes of the general price inflation experienced in the U. S. in recent years. The causes of the general price inflation are basically two in number: (1) excess purchasing power generated by loose fiscal and monetary policies at the national level, and (2) the widespread involvement of cost-push action wherein big labor and big business collaborate in passing wage increases along to the consumer in the form of higher prices. Both of these basic causes are at work in most Western industrialized nations, hence most of these nations are experiencing a general price inflation similar to that occurring in the U. S.

There is nothing to suggest that the general price inflation that we have lived through for the past seven or eight years will come to an end soon. We are learning to live with inflation. Every worker and retiree, too, now expects a cost-of-living increase each year. Such cost-of-living increases are then pushed along in the form of higher prices. And so the price-cost-price spiral continues.

During the past two years a tight world grain situation has operated to push farm and food prices to record high levels in the U. S. Several of the forces discussed in this section will operate to raise farm and food prices. Thus, rising farm and food prices could play a greater role in the future than they have in the long-run past in the price escalation process. The operation of the farm economy could in the future, as the record of the past year suggests, become the third basic contributing cause of general price inflation.

III

The model of the American agricultural economy that takes shape for the coming 10 years from the foregoing discussion may be described as follows. The prices of nonfarm-produced inputs are going to rise steadily. Additional land, generally of poorer quality than that now in production, will be drawn into cultivation. Increases in production efficiency will occur slowly and irregularly. The real cost of producing food will rise. The export demand for American farm products (based in part on the food needs of the LDC's, but more importantly on the upgrading of diets in the developed nations) will remain strong, causing the aggregate demand for farm products to press against aggregate supply. The real price of farm products will trend upward over the 10-year period. The increase in the real price of food will be fed into wage bargains, the loan-rate and target-price system of the farm programs, and the social security system and thereby further feed the inflationary fires.

In short, I am hypothesizing the long-run situation alluded to, but not developed, in my Fellow's Address of 1970. Events unforeseen by me at that time have telescoped the long-run situation into the present situation.

But my model descibes an eventless situation and the resulting price trend. Even if I have captured the essence of the next 10 years in my model, the reality will be different in some unknown way. First, the weather will play tricks with the model. Second, important trading nations will take actions which cannot now be foreseen that will alter the flow of imports and exports (e.g., devalue their currency, raise import quotas, elect to build food stocks). Third, new wars could break out. Fourth, the fuel shortage could give rise to a severe economic depression in, for example, Japan and/or Western Europe. And given the extreme inelasticity of demand for the grains and the network of world trade of which the U. S. is now an integral part, the occurrence of any one or combination of the above unpredictable events could give rise to a sharp and major decline in farm prices with the return of physical surpluses in the U. S., or to a sharp and major rise in farm prices with a further tightening of stocks. The timing and magnitude of these roller-coaster-like movements in farm prices can in no way be predicted, since the events cannot be predicted.

The food and agricultural situation for the next 10 years which in my judgment confronts policy makers around the world, and in the U. S. in particular, is thus of the following form: a farm price level which gyrates in an extreme and unpredictable fashion around an upward trend in the real price of farm products, the latter of which contributes to the general inflationary spiral.

IV

What kind of national policy is needed to cope effectively with the kinds of developments in food and agriculture hypothesized above for the coming decade? First, that policy must have the capacity to deal with a continuing pressure of demand on supply, rising costs of producing food, and a long-run increase in the real price of food. This represents a new development for domestic agricultural policy. Second, the policy must have the capacity to turn around quickly to deal with short-run production and trade aberrations from trend—to deal with unpredictable short-run shortage and glut situations. Thus, the policy must be flexible—highly flexible.

How does the Agriculture and Consumer Protection Act of 1973 meet the test of these policy requirements? Tweeten and Plaxico give it high marks with respect to the flexibility requirement [5]. Although I am of the opinion that the 1973 Act may be the best farm bill ever passed, it fails the flexibility test with regard to loan rates and target prices since it projects them four years into the future at fixed levels. And the Act is silent with regard to a number of problems that are likely to be encountered in the food and agricultural sector during the coming decade. Thus I argue that new legislation will be required in the not too distant future either modifying the Act of 1973 or adding entirely new pieces. I turn now to those modifications and additions.

To render the new pricing concepts—the loan rate and the target price—relevant and socially productive in a situation in which the real price of food is trending upward, but in which farm prices in the short run are fluctuating unpredictably around the trend, the loan rate and the target price for each commodity should be reexamined each year in light of changing conditions and be reset for the crop year ahead. These prices should be set and announced each year by the chief officer in the food and agricultural area under guidelines established by Congress. The principal guideline for setting the loan rate should be a moving average, say, a three-year moving average, of the world price. The principal guideline for establishing the target price should be a price which yields a parity of income for an efficient-sized family farm.

One important area on which the Act of 1973 is silent is that dealing with a reserve stock program. This is strange, since it was passed in the midst of the greatest upward thrust in farm prices in peacetime history, and the title of the Act includes the phrase "Agriculture and Consumer Protection."

Basically, the United States in 1974 finds itself in the following position.

1. It is the largest supplier of food grains,

feed grains, oilseeds, and oilseed products to the world market, and it is fully integrated into the world market.

2. Its reserve stocks are at a minimum; it is pursuing a "bare shelf" reserve stock policy.
3. Neither it, nor any other country, can predict supply-disposition developments beyond the current crop year.

Given the inelastic aggregate world demand for grain, a modest reduction in world cereal production in 1972 produced skyrocketing prices in the U. S. in 1973. Poor crops around the world in 1974–75 could give us more of the same in 1975–76. Or a series of good crops around the world, and bountiful supplies, could lead to a serious farm depression in the U. S. Such is the fate of a large residual supplier to the world market who is pursuing a bare-shelf, free-market policy, namely, the U. S.

If the U. S. is to reap the advantages of being a major supplier to the world market and avoid the disadvantages, it must develop a food and agricultural policy which enables it to sustain and increase its export sales while at the same time protecting itself from adverse, unpredictable worldwide market forces. *The cornerstone of this policy must be an effective reserve stock program.* The principal goal of this reserve stock program is the maintenance of a reasonably stable domestic farm price level—a level that moves within a defined range—acceptable to farmers and consumers alike. The lower side of this range might well be the loan rate for a given commodity, and the upper side the target price concept. In the effectuation of this price stabilization goal, the reserve stock program would operate as a giant balancing wheel, pouring supplies onto the market as individual commodity prices approached the upper side of the stabilization range, and withdrawing supplies from the market as prices dropped to the lower side of the stabilization range. Thus the program would seek to even out supplies coming onto the domestic market over time and thereby stabilize the farm price level within an acceptable range.

I will not attempt to lay out the operating mechanics, commodity magnitudes, and budget costs of an effective reserve stock program in this brief paper. In part, I dealt with these issues in my recent essay *Feast or Famine* [1, p. 14], and a good many others are currently at work on the basic features of a reserve stock program. But I would argue here, as strongly as I know how, that a reserve stock program properly integrated with a domestic supply management program and an explicit agricultural export policy is essential to food and farm price stability in the U. S.

Let us turn now to the courses of action that the U. S. will need to pursue if, as is hypothesized in this paper, the real price of food trends upward in the long run. But before we can discuss such courses of action meaningfully, we need some bearing on the gradient of that price trend. If, for example, energy prices level off and perhaps even decline modestly from present levels, and modest increases in farm prices bring additional land and labor into agricultural production, as well as induce significant farm technological advances *à la* Vernon Ruttan, so that the upward trend in farm and food prices is a moderate one, then we may need no resource and food distribution programs in addition to those already in the books. The above situation would represent a rerun of those wonderful years 1900 to 1914—increasing employment opportunities in agriculture, steadily rising farm asset values, and moderately rising food prices. An administration that came into office in such a period would be lucky indeed. It could win big by doing nothing.

But if energy prices should soar, world demands for agricultural commodities press strongly against supplies, and additional units of land and labor move into agricultural production in the U. S. only haltingly, then we could expect the real cost of producing food to rise sharply and painfully. Land rents would become excessive, the real incomes of consumers would be reduced significantly, and the inflationary spiral would be given increased impetus. In such an event strong pressures would certainly arise to modify old policies and programs and to add new ones.

Although I do not predict this latter unhappy development with any greater probability than I do a "second coming" of the "golden age" of agriculture, or something in between, I think that it is instructive to consider the policy implications of the pessimistic case. By investigating the policy implications of the pessimistic case, we gain perspective on the food and agricultural policy needs of the U. S. for the range of possible situations in which the real price of food is rising over the long run. So let us turn to the pessimistic case.

In the event that we move into a prolonged period in which the real price of food is rising rapidly, it will, I believe, be necessary to modify old policies and develop new ones in three general areas: (1) resource use, both physical and human, (2) production research and development, and (3) food distribution. With respect to the employment of physical resources, and keeping in mind the twin objectives of moderating the rise in the cost of producing food and protecting the environment, it may be necessary, for example, to ban the use of nondegradable chemicals and to provide incentive payments to producers to employ practices which conserve the soil and do not pollute the environment on the one hand, while subsidizing the use of energy in farm production and redirecting the use of water in irrigation through differential pricing on the other hand.

In other words, it may be necessary to develop a general resource policy with many and varied provisions, affecting all the principal physical inputs, with the multiple objectives of increasing output, reducing unit costs of production, and achieving a clean nonpolluted environment. Central to this concept of a general resource policy must be a holistic approach to resource use in which policy provisions governing the use of one resource (e.g., energy) are formulated and executed only after the interaction with all other inputs is considered and taken into account. Independent policies governing the use of each principal resource would lead to production chaos. A holistic, general physical resource policy aimed at reducing the cost of key inputs through subsidization could well be an indispensable part of any general solution to the problem of rapidly rising food prices over a long period of time.

To improve the quality of farm workers specifically and rural workers generally, hence improve their productivity, and to improve the real level of living of families living in rural areas, hence increase the supply of high quality labor in those areas, I suggest the need for a coordinated human resource policy. This policy should include programs in several areas. I suggest five important areas here: (1) education, (2) health care, (3) worker benefits and protection, (4) housing, and (5) community recreational services. The inferior quality of primary and secondary education in rural areas has been documented over and over again, and the great need to strengthen general and vocational education in rural schools has long been recognized. On human grounds it is time that this shortcoming be remedied. But in a prolonged period of rapidly rising costs of producing food, it is essential that effective action be taken to improve the quality of the working force available to agriculture.

The lack of adequate medical services and the poor quality of health care in rural areas has also been documented over and over again. The need for improved medical services and health care in rural areas is obvious. I do not need to state the case for it in this paper. What I need to do is state the case for the political will to do something about this human disaster area.

We should recognize once again, and in capital letters, that federal labor legislation has systematically discriminated against farm workers. Farm workers are excluded entirely, or in part, from the following federal benefit programs:

1. the right to bargain collectively
2. unemployment compensation
3. Workmen's Compensation coverage
4. coverage under the Fair Labor Standards Act
5. coverage under the Federal Equal Pay Act.

In some of the areas noted above farm workers are covered by state legislation. But that coverage is exceedingly uneven. What is needed, and what is coming slowly, is identical or comparable coverage for farm workers under federal legislation. Such federal coverage would greatly increase real levels of living in rural areas.

I cannot, because of limitations of time and space, enter into a discussion of ways and means of realizing the social goals noted above, even if I knew them, or of finding ways and means of providing decent housing for the rural poor or lifting the dreary sameness of small town living. But I must relate this discussion of rural welfare to the central argument of the paper. First, given the pessimistic scenario in which the real price of food is rising rapidly, and there is need to pull additional human and land resources into agricultural production, the improvements in rural welfare outlined above could well be necessary to call forth the additional supplies of labor that are needed. Second, if there is any logic in having society assist consumers of food and farm operators find solutions to their equity problems, then there must be logic in helping farm workers and agricultural service workers find solutions to their equity problems. Americans have been slow to recognize this logic, but slowly and inevitably, like the movement of a glacier, the recognition is coming.

If we as a nation encounter a prolonged period of sharply rising food prices, we will be forced to take a careful look at our research and development establishment. The agricultural research establishment of the U. S. has been held up to the world as a prize exhibit for many decades. But as we noted earlier, farm technological advance has sputtered during the past 10 years, and more recently the establishment has received some sharp criticism. The popular report *Hard Tomatoes, Hard Times* [2] dramatized some of the inadequacies of the Land Grant College complex, and the prestigious National Research Council of the National Academy of Sciences had this to say with respect to the program areas and organizational structures of both the U. S. Department of Agriculture and the state agricultural experiment stations.

> . . . It has found many programs of excellence both in terms of scientific quality and of mission. . . .
>
> But to acknowledge these findings is not in itself adequate. Acknowledgment must also be made of findings that indicate that much of agricultural reseach is outmoded, pedestrian, and inefficient, and that bold moves are called for in reshaping administrative philosophies and organizations, in establishing goals and missions, in training and management of research scientists, and in allocation of resources. [4]

Because of the heavy emphasis on the training of technologists and scientists in the Land Grant College complex, on fighting day to day brush fires in the U. S. Department of Agriculture complex, and on the development of quick, high-payoff, salable technologies in the private industry complex, the important mission of developing basic scientific knowledge and converting that knowledge into new production technologies (e.g., hybrid corn) is not being pressed. Each major component of the agricultural research establishment is busy doing its special thing, and the central mission of developing important new scientific concepts and transforming those concepts into improved production techniques is being bypassed.

Thus, if the pessimistic situation materializes, I feel sure that the agricultural research establishment will receive careful scrutiny, and properly so, in an effort to increase agricultural productivity. I am not in a position to make specific recommendations regarding the reordering and restructuring of agricultural research. But of this I am sure—the political pressure to reorder and restructure will be very great, given the long-run pessimistic situation. Further, the pressure to take additional funds for research activities will be very great. But it will not be a free ride; the politicians are going to demand a technological payoff comparable to that which occurred in the 1940s and 1950s but this time with a cleaner, less polluted environment.

If food prices rise rapidly over an extended period of time, the political pressure to do something about the high cost of food will become intense. We have been discussing ways and means for dealing with soaring production costs in a long-run situation. But there will be strong demand for doing something about the price of food *now*. It is highly likely that there will be demands to roll back the retail price of food, which in a highly interdependent, complex economy such as that of the U.S. could only lead to production and distribution interruptions and chaos. And I am sure that there will be many and loud complaints against the middlemen, as consumers eat more and more T.V. dinners; but this, as always, will turn out to be a futile exercise.

What will be required, and what surely will occur after the necessary "backing and filling," is an expansion of food distribution programs, subsidized in part by the federal government, and aimed at specific needy groups. I have in mind the following:

1. a further expansion of the food stamp plan to assist all low income families
2. increasingly subsidized school lunch and preschool feeding programs to help protect these vulnerable age groups
3. subsidized in-plant feeding programs to reduce the clamor for wage increases
4. possibly direct food distribution programs for heavily depressed areas.

Some in the audience may be saying that we would not need these specialized food programs if we were wise enough to adopt a universal minimum-income program. To that I would say, "I agree," but until we adopt a universal minimum-income plan, we will have need for various kinds of specialized food distribution programs, and such programs will constitute an important part of the administrative machinery of government.

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In conclusion I would like to turn to some organizational implications of the foregoing policy points. The reserve stock program with its objectives of evening out supplies and stabilizing prices over time could, without difficulty, be made one title of the Agriculture and Consumer Protection Act of 1973, and the program could be administered without difficulty in the presently constituted U. S. Department of Agriculture. In fact the logic of program operations suggests that it should be made an integral part of the USDA since (1) the operation of the reserve stock program would need to be related in a harmonious fashion to loan rate and target price concepts of the Act of 1973, and (2) the staff of the Commodity Credit Corporation has had valuable experience operating a large-scale storage program. Of course the basic mission of the reserve stock program proposed here would need to be spelled out clearly in legislation to insure against the subversion of that program by unsympathetic administrators.

But the scenario of a long-run upward trend in the real price of food, where the price trend is steeply inclined, represents something new, indeed. Americans in their whole history have had no experience with such a development. If it should occur, it would represent a fulfillment of the arguments set forth by the English classical economists with regard to agricultural development.

The policy measures required to moderate and make tolerable the pessimistic developmental situation would also represent a fundamental shift in farm policy. A coordinated resource policy would be required to insure a rapid growth in agricultural production. The spotlight would once again be turned on agricultural research and development, but this time to save society, not to assist farmers. And all aspects of surplus disposal would certainly be gone from the food distribution programs.

Now where and how should these wide-ranging policy measures be administered? It could be argued that these various programs should be severed one from another, with one going to the Department of Labor, others going to Health, Education and Welfare, and another to some new independent agency established to deal with the chronic food problem. Or it might be argued that these programs along with others in the USDA should be divided among the four super agencies proposed by President Nixon in 1971. But in the former organizational proposal all semblance of coordination among the programs would be lost, and in the latter organizational proposal the unique aspects of American agriculture and its special problems would be lost in super agencies dominated by an urban culture.

In my view the policy and program needs of the pessimistic developmental situation call, not for the scaling-down or the elimination of the present U. S. Department of Agriculture, but rather for a new and enlarged concept of that Department. In my view the Department should be given three distinct but highly interrelated missions: (1) the promotion of a prosperous and productive commercial agriculture, (2) the promoting of an efficient food distribution system in which the food requirements of vulnerable groups are assured, and (3) the promotion of rural economic development and the improvement of rural welfare. The U. S. Department of Agriculture should be enlarged in concept, restructured as to mission, and renamed the *Department of Food, Agriculture and Rural Welfare.*[1]

A department so structured would be in a strong position for dealing with the varied problems currently swirling around the food and agricultural sector. And it would have the structural capacity to grow and assume the responsibility for launching and coordinating the far-ranging policy measures required by the pessimistic developmental situation. I do not mean to suggest that a Department of Food, Agriculture and Rural Welfare would become involved in (a) subsidizing different forms of energy to farmers, (b) operating vocational training programs in secondary schools, and (c) the establishment of collective bargaining machinery. But in the concept taking shape here, the Department would have an initiating responsibility and a coordinating responsibility even where actual program administration might fall in another department (e.g., an educational program for rural areas). Finally, I would argue that only a department as broadly structured with regard to mission as that envisaged here could hope to coordinate the varied policy measures that would of necessity be called into play to deal with a prolonged period of rising production costs and the price of food. If and when the world changes, so must policies and organizations.

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[1] For a good discussion of this point of view, see [3].

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INVITED ADDRESS

Conflicts Over Changes in Scarcity: An Economic Approach

THEODORE W. SCHULTZ

If WE KNEW how to arrive at social unity freely and openly, we would have the key to a Good Society. If reasoning could reconcile the ideologies that divide men, there would be some hope for discussion achieving the desired goal, but talk does not, as a rule, bring about social unity. Frank Knight said it succinctly: "The more intelligent people are, the more certain they are to disagree on matters of social principles and policy, and the more acute will be the disagreement."

Not knowing how to reconcile differences in values and beliefs, the art of economics is to conceal these differences. It is done so astutely that we come to see only social unity. Our models are virtually foolproof in immunizing graduate students against the divisiveness of Marx, Veblen, and Commons and other mavericks. But despite our protective apparatus the conflicts that divide people persist. Marx was wrong, however, in his belief that governments would wither away under his economic system. Veblen's property owning leisure class has come to count for less and less, as high wages and salaries have come to dominate personal incomes. The legal foundations of property, the hallmark of Commons' approach, have also diminished in economic importance. The virtual elimination of private property and of class distinctions, as announced in principle by the governments of China and the Soviet Union, has not led to social unity within or between them. Our own foreign policy of imposing political unity within other countries has been anything but successful. Nor are we spared disunity within the United States; consider, only, such recent divisive issues as the environment, pollution, energy, and discrimination.

Intellectually there is a woeful lack of comprehension of the universality of the struggles for scarce resources. It is as old as human life, reaching back far beyond known history. Nor are animals spared as is clear from their struggle for territorial rights. Struggle for existence of the members of any natural population is the mainspring of Darwinian evolution. Economic competition in accordance with established rules is one part of this struggle.

Although it is true that the sources of conflicts that divide people and the changes in them over time are exceedingly hard to comprehend, especially so for economists who hold fast to a consistent unified system of preferences, we could do much better than this by extending the domain of economic analysis. How useful such extensions would be is not predictable, but there are good reasons for giving them a try.

Human conflicts are not occasional events; on the contrary, they are as universal and persistent as resource scarcities. Both are basic attributes of human circumstances that are ever present. They may be viewed as two overlapping domains, and economic analysis is applicable to the overlapping parts where there are conflicts that pertain to the scarcity of resources. My approach is to look for the interactions between them. I shall treat resources as the supply constraint and the conflicts pertaining thereto as belonging to the demand for them. It is my contention that regardless of the ideology of a society, of the type of government, or of the organization of the economy, resources never have been and never will be unlimited; and the disagreements about their allocation and how the benefits derived from them are to be shared will not fade away no matter how rich people become. Building on this proposition of the interplay between resources and conflicts, economics should have a good deal to say because the foundation of economic analysis is the scarcity of resources for satisfying human wants, whether or not they are neatly consistent wants. It follows that the class of human conflicts to which this paper is addressed would not exist in a Utopia in which there were no scarce resources. But a search for such a Utopia is as pointless as looking for the Holy Grail.

Aside from reconciling differences in scarcity by means of the market, standard economic

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theory is not designed to analyze social and political conflicts over scarcity. Economics, as already noted, deals with the implications of a socially consistent set of preferences in a context of a specified set of resources from which it derives the properties of an economic equilibrium. Although the concept of an equilibrium can be a useful guide in analyzing disequilibria, social and political responses to basic changes in scarcity of resources are not at home in standard theory.

In my thinking many social and political conflicts that pertain to changes in scarcity can be treated as manifestations of disequilibria. The objective is to resolve such conflicts in the context of adjustments that tend toward an equilibrium. The basic implication of this approach is that when a society arrives at such an equilibrium, there would be no conflicts of this type. What we observe, however, are all manner of disequilibria; moreover as some of these are resolved, changes in resource scarcities and related events give rise to numerous new disequilibria and to conflicts with respect to how the losses and benefits entailed by these disequilibria are to be distributed. It is indeed a never ending process. But by holding fast to the proposition derived from the concept of an equilibrium, we have a useful guide in bringing economic analysis to bear on this important class of ever present human conflicts. It should be obvious that I am not assuming that all of these conflicts can be resolved by a market economy; on the contrary, some of them can only be resolved by political processes and by social and legal institutions.

Our own political history is replete with human conflicts; for example, as we emerged from colonial status to that of an independent country, the federation of the several states was a loose accommodation of many diverse conflicting interests. Charles Beard saw the federal constitution as a compromise of the major economic interests of that period. The pre-Civil War conflict between the slave owning planters of the South and the anti-slavery North proved to be intractable politically. It is all too easy to forget the long standing political conflict between the free trade agricultural South and the industrial protectionism of the North. The Granger and Populist movements in opposition to railroads and other industrial elements of monopoly and to the thorned "crown of gold," a proxy for the gold standard then, are all very recent. Our historical perspective is short as we forget these deep seated conflicts of the past, and we tend to exaggerate those that are upon us presently.

Economic Changes That Engender Conflicts

The oil embargo, the purchase of vast quantities of wheat by the Soviet Union, the dishpan parades in Chile, and our own meat boycott all come to mind as recent events associated with abrupt changes in supply. The gradual increases in crop yields, the large reductions in acreage devoted to corn and cotton since the thirties, the 40 year rapid decline in the U. S. farm population, and the marked rise in the economic value of human time are all secular changes that are, in general, non-reversible.

The supplies of various resources in a modern economy are constantly undergoing change. Viewed as supply curves, some change abruptly, some gradually become more or less steep, and most of them shift unevenly to the right over fairly long periods of time. These changes are of two general types, one of which is a consequence of developmental factors, and the other occurs as a result of sporadic and concurrent instability that affects the supplies of particular resources abruptly. Both engender social and political conflicts. Those associated with sporadic instability are, as a rule, in the forefront of public concern. The welfare effects of the persistent, secular developmental factors are, however, more important in terms of real changes in scarcity. I shall for this reason consider mainly the conflict behavior related to developments affecting the scarcity of resources. With respect to supply, standard theory gives us a set of positively inclined supply curves but leaves us in the dark with regard to the processes that shift these curves to the right.

We are adept in using the concept of demand confined to observable market behavior. Theory guides us in deriving the price effects, but we are dependent upon the data in ascertaining the income effects. It is all rather simple when the personal distribution of human and non-human capital is given. When income and relative prices change gradually over time, the concept of demand confined to market behavior remains useful. Moreover, some expected fluctuations in income can be analyzed by separating the effects of the transitory and permanent income components on the demand. So far so good. But the problems associated with social and political conflicts introduce "demands" that go beyond those that are observable in market behavior. The fact that these "demands" are not revealed in the market does not make them illegitimate. Although most of the rhetoric on behalf of these "demands" appears to imply that they can be satisfied at virtually no costs, economic analysis has contributed all too little in determining the resources that would be required to satisfy them. Consider how little we know about the economic effects over a generation and longer of satisfying the demand for a more equal personal distribution of income, and for public services related to schooling, health, housing, and our food stamp program. To the extent that scientific research gives us public goods, are our public expenditures on such research close to an optimum? The demand for more environmental quality entails a very complex array of costs that the Environmental Movement fails to reckon. All of these issues call for analysis that goes beyond the market, and so does a large part of the allocation of scarce resources in household production.

We have a plethora of growth models, a lot of doomsday "limits of growth" projections, and a wide array of indexes of resources; but we have very little economic knowledge of the underlying factors that account for the vast increases in resources over time. However, some of the economic development literature, a good deal of it by agricultural economists, is beginning to establish a taxonomy of the growth processes. See, for example, Kuznets [6],[1] Ruttan [9], and Schultz [12, 13, 14, 15]. But these contributions are not yet at home in theoretical economics.

The early English economists, notably Ricardo and Malthus, saw economic development occurring under conditions where the supply of food producing land is highly inelastic and subject to strong diminishing returns and under social conditions where population growth tends to exhaust the gains from capital accumulation including the gains from the advances in the productive arts. According to their model the share of the income of society accruing to landowners increases, giving rise to critical social and political conflicts between landowners and other economic classes. In the realm of ideas about class conflicts, including a good deal of economics, the Ricardo-Malthus model continues to hold sway despite its obvious inconsistency with the facts of modern economic development. These facts do not imply, however, that landowners in some of the low income, less developed countries, are not a source of conflict with regard to social principles and policies in a modernizing economy.

Our economic knowledge is still far too incomplete to identify and measure the effects of the various processes that account for modern economic development. Not knowing more than we do about these processes, theory is wanting and models obviously require theory that is appropriate to the task. We need to explain the marked secular rise in the real earnings of labor, the decline in the share of income accruing to owners of property, and the secular decreases in the economic scarcity of material resources. Why has the price of the services of material goods declined so much relative to the price of human time during the last three or four decades, prior to the abrupt price distortions of the last two years? Although we are troubled and much confused by the high rate of inflation, by the recent sharp increases in primary product prices, including farm commodities, by the devaluation of the dollar, and by the oil supply control by the Arab oil producing countries, the prospects are that the pervasive developmental factors of the fifties and sixties, which are presently swamped by all manner of distortions, will again prevail.

An Appeal to Developmental Propositions

By going beyond the boundary of standard theory, economic analysis can be extended to deal with some of these developmental changes in the supply of and demand for resources. We can analyze the effects of man-made substitutes for farmland, the effects of modernization of agriculture on the environment, the effects of the research sector on the scarcity of resources, the effects of human capital on production and consumption, and the effects of the rise in the value of time on household production, investment in children, and fertility. I shall approach these effects by presenting briefly and with a minimum of evidence the implications of a series of developmental propositions.

1. The first proposition pertains to the new opportunities favorable to the reallocation of land to nonagricultural uses and to the decline of the role of the owners of farmland in our economy. Urban people are demanding more land for industry, residences, recreation, and for a more satisfying environment. In large part it is the increases in their income that make their demand effective, and the modernization of agriculture contributes to the supply. Our bias, however, is to resist such reallocations of land because of a deep-seated belief that good farmland should never be paved or put to urban uses, as insurance against a shortage of land suitable for

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[1] Simon Kuznets has made notable contributions; see especially his Nobel Prize lecture, published in [6].

agriculture. But the supply effects of agricultural modernization do not support our bias on this issue. The virtually fixed land area suitable for growing crops is not the critical factor of production in increasing the supply of agricultural products as it was envisioned by Ricardo. The economic importance of cropland declines as a consequence of the modernization of agriculture. Although only about one-tenth of the land area of the earth is cropland, its productivity in high income countries has, in general, been vastly increased by investments in land improvements. More important still are the man-made substitutes for cropland.

The major implications of this proposition are the following: (1) the value productivity of the original, natural properties of the soil (Ricardian) declines relative to that of the land improvement investments that are made by man; (2) farmland rent declines relative to the other costs incurred in agricultural production and relative to the total retail costs entering into the food and fiber chain serving consumers; (3) real wages rise relative to farmland rent in constant dollars; (4) farmland rent becomes a very small component in our national income; (5) owners of farmland as a class become very small compared to the other economic classes in the economy; and (6) at many margins over space throughout the economy some farmland becomes more valuable for nonagricultural uses than for agricultural production. I contend that economic studies should clear the way for orderly transfers as is our wont. Such studies could contribute substantially to a reduction in the apparent social conflicts that characterize this area of development. In principle the same reasoning applies to the allocation of water between agricultural and urban uses.

2. The next proposition pertains to the interaction between agriculture and the quality of the environment. Presumably the demand for environmental quality exceeds the supply. Our political institutions are telling us that the market sector is not satisfying this demand for quality. I take it to be true that there are, in fact, various significant disequilibria. The key difficulty in analyzing these disequilibria is in identifying the real demand. The political movements to obtain more environmental quality do not in general reckon the full costs of the additional quality. The quality that is wanted is not a free good. Nevertheless, when these costs have been fully reckoned, we will, in fact, discover that there are many real disequilibria, and we will also find that the increases in the demand for environmental quality are, in large part, the effect of the marked rise in personal incomes. In my view our economy faces many adjustments in coming to terms with the real demands for additional environmental quality. Meanwhile, what we observe are unresolved conflicts of interest much confusion, a lack of clarity with regard to the evidence, and a lot of rhetoric. Clearly the environment is a scarce natural resource, a resource that encompasses a wide array of physical chemical, and biological attributes. It is obvious that these attributes of nature affect agriculture and that agriculture, in turn, affects these natural attributes of the environment.

We need to remind ourselves that public concern about the misuse of our natural resources has a long history. The New Deal launched a series of programs devoted to soil conservation Shelter belts of trees to impede wind erosion and terraces and water courses to reduce soil erosion are the more visible contributions of these programs. In fact, however, the Conservation Movement started long before the New Deal.

For the purpose at hand, I shall concentrate on reconciling the high income effects on the demand for more food that require additional agricultural resources and for additional quality in the environment to the extent that it is affected by agricultural activities. The basic proposition that should guide our analysis in this connection is that the process of modernizing agriculture tends to shift the biological possibilities of nature to the right and thereby enlarge the real opportunities to satisfy the increases in these two demand components, Schultz [16].[2] It is a process that makes it possible to have more of the costly foods and also more of the environmental quality components over time.

The major implications of this proposition are that these favorable shifts of the biological possibilities of nature change our options in the following ways. (1) They reduce the acreage required for our major crops. With respect to corn wheat, and cotton, the three major crops during the early thirties, the farmland devoted to them had declined by about 76 million acres prior to the price explosion of 1973; and, the combined production of corn and wheat more than doubled (2) The much reduced corn and cotton acreage the two large row crops that are associated with soil erosion when planted on hilly land, are now being grown on land that is, in general, much less subject to soil erosion. It is noteworthy that in Mexico the improved wheat varieties have also made it possible to concentrate the wheat acreage on what are mainly irrigated areas that are not subject to soil erosion. (3) The mechanization of agriculture has made possible many improvements in the control of water and thereby has reduced the adverse effects of uncontrolled water on the natural environment. (4) The mechanization of agriculture in the Plains States of the United States has substantially reduced the vulnerability of that area to the extraordinary dust storms that characterized the mid-thirties.[3] In the application of commercial fertilizers, modern agriculture has not yet come to terms with some aspects of its effects on the biological environment. A more controversial issue pertains to the uses of chemicals for plant protection including weed control. In solving this issue it is essential to understand the inherent hostility of nature to domesticated crops (also to all domesticated animals). It is fair to say that as yet the Environmental Movement has failed to reckon the food supply implications of abolishing the uses of chemicals in agricultural production; nor have we contributed appreciably to the clarification of the effects of this option compared to alternative options.

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[2] In [4] I present in detail the implications of this proposition.

3. Although there is much unnecessary ignorance about economics of the agricultural research sector, we know enough to deal with the following questions: (1) Is it worthwhile? (2) Who benefits? and (3) Who should pay the bill? But there must be something in the sociology of agricultural economics that accounts for the general neglect of these questions. Is it because of our bias against virtually all aspects of economic history? Clearly organized agricultural research has a long history with a lot of evidence on its performance.[4] Is it because this research is largely outside of the market sector? In fact agricultural research is an important endogenous part of our economic system. It contributes substantially to the increases in the supply of resources and thereby to the gains in real income of society. Viewed comprehensively, Vernon Ruttan [10] has put it cogently, "The impact of science and technology has been to expand the size of 'space ship earth' along those dimensions that are most significant for human existence." The rate of return on public expenditures in support of agricultural research is in general much higher than the "normal" rate of return to alternative investment opportunities. Robert Evenson's studies [1, 2, 3, 4] show that the research investment opportunities associated with agriculture are better in the less developed than the more developed countries, and they show a higher rate of return to scientific investigations than to applications, although both are above the "normal" rate. The adoption process of the useful contributions of this research indicates a greater gain by better educated and more informed farmers relative to the other farmers, and once the adoption process has been completed, the gains are transferred to consumers via competition.

The useful contributions of scientific investigations have the attribute of a public good. We have the analytical tools to determine not only who should pay for such research, but also to ascertain approximately the amount of resources that should be allocated to these endeavors. Yet all too small a fraction of our economic talents is committed to this task.

4. Disagreements about the human effects of technology are acute. Most intellectuals see modern technology as a curse like original sin in theology. They see it as bad for labor, for the yeoman farmer, for hapless consumers, and for the natural environment. Worst of all it debases our values. Many economists are ambivalent and understandably so because the concept is a Pandora's box. Unless one is striving for ambiguity, it is the better part of valor to avoid the term "technology" and deal instead with the production, price, and income effects of specific new agricultural inputs. But even then there is a tendency to add to the confusion. For example, we have a raft of papers without evidence proclaiming that the adoption of Mexican wheats in India worsened the economic lot of agricultural labor and left the small farmers behind. In fact, however, the adoption of these new varieties has increased the demand for labor, and real wages have risen. Moreover, small farmers got into the

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[3] See Johnson and Gustafson [5] for evidence in support of this implication.

[4] See the essay by Andre and Jean Mayer [7]; the essay begins as follows:

> Few scientists think of agriculture as the chief, or the model science. Many, indeed, do not consider it as a science at all. Yet it was the first science—the mother of sciences; it remains the science which makes human life possible; and it may well be that, before the century is over, the success or failure of Science as a whole will be judged by the success or failure of agriculture.

Several parts of this essay contain important historical insights pertaining to agricultural research. In learning from these insights, one need not accept a number of the authors' naive national and international policy proposals.

act more promptly than might have been expected. While the effects of the new wheat varieties on the personal distribution of income among farm families could not have been predicted, there are now two studies, Satyanarayana and Muralidharan [11] and Singh [19], that show that in fact it has reduced the inequality.

In my view the present approach to agricultural development of the World Bank in low income countries, which in effect calls on scientists to come up with new varieties of wheat, rice, and other crops that will increase the yields on small farms but not on large farms, is an absurd approach. A not unrelated line of reasoning is implicit in some proposals to reform U. S. agricultural research—be it for soft tomatoes that require more farm labor or for administering the research so that it is fully responsible for all of its human effects. A recent paper by Randall [8] equates research information with power and distortions and concludes that agricultural experiment stations and universities generally should not release any useful information derived from their research unless and until they have produced complementary research findings that would with certainty offset fully the "power" effects of whatever information they release. Although Randall deals with an important problem, his solution is far too extreme to be meaningful.

5. The last proposition to be considered here deals ever so briefly with human capital. The investment in human capital begins in the home primarily by what mothers do for their children. It continues with the acquisition of schooling and experience and with provisions for health. Then, too, for many people it entails migration; and, for virtually everyone it involves the acquisition of abilities to deal with social and economic changes. The education of women has a strong negative effect on fertility; it also increases the quality of the home investment in children; and it contributes to health and to the efficiency of the household production (Schultz [17, 18]). Since over four-fifths of our national personal income consists of earnings, even though the measurement of it omits the contributions of housewives to real income in household production, changes in the level and personal distribution of the stock of human capital have strong effects on the personal distribution of income.

It has long been evident that the existing functional distribution of income by the market and by public income transfers including public services are not sufficient to satisfy the social and political "demands" for less inequality in the personal distribution of income. It is also true that the personal distribution of income among farm families is more unequal than it is among urban families; furthermore, farm children in general acquire fewer of the quality components than do urban children. One of the important keys in resolving these social problems is in the personal distribution of human capital.

Like Alice in her Wonderland, I have given you five propositions and that is enough. The time has come to turn to more (less) important things.

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Session 6

ECONOMIC RESEARCH AND EDUCATION FOR COMMERCIAL AGRICULTURE

CHAIRMAN: R. JAMES HILDRETH, FARM FOUNDATION, CHICAGO, ILLINOIS

Perspective on Research and Education for Commercial Agriculture

ROBERT W. LONG

THE STATUS of agricultural research and the ultimate transfer of this technology into useful purposes has come into very sharp focus in recent years. As a farm manager, banker, and armchair economist, I have had to delve deeply into this special universe in an effort not only to understand better its mechanisms and orientation, but hopefully to find an approach which would result in more effective answers.

Simply stated, the issue for agricultural research and extension is how to find the means to sustain a high level of awareness and public support for this critically important component behind our food supply system. The problem is that when worldwide food stresses are surfacing in various alarming proportions, we are at the same time experiencing serious declines in scientific investment in food and fiber, both public and private. Further, we have invested substantial public funds in the development of technology which often remains on the shelf and thereby is not transferred into useful application. Let us discuss the research side first.

The reasons why we are in difficulty are not hard to assess—the answers to how we uncouple the needed financial resources are far more difficult. Nothing unusual in this comment, but what worries me is the lack of vigor with which we are facing up to the problem.

No one seems to challenge seriously the proposition that research and its effective transfer into useful technology through education is the basis of most progress—yet many are standing by like spectators and watching the slow but continuing decline of the greatest agricultural research and extension system ever assembled by one nation.

As stated earlier, the reasons are not too difficult to analyze:

1. Many people feel, have publicly advertised, that public ag-research is redundant, over-mature, pedestrian, wasteful, and inefficient. Among the critics are a significant number of scientists, including economists.
2. Other research and education disciplines, such as human health, space technology, and social sciences, have attracted wider support—better salesmen with a highly visible product, I suppose.
3. High costs of specialized hardware and professional personnel are associated with the decline. ARS is currently operating in terms of real dollars at levels experienced 15 years ago and will probably go still lower. Similar patterns are true for most State Experiment Stations.

There are more reasons for the decline such as debilitating interdisciplinary squabbles, severe public budget constraints, and other priority issues, but the single factor of greatest significance lies in the lack of industry and public support. Some of the problems stem from their being unaware of the long-term consequences should agricultural research programs be allowed to erode further. One facet of the problem comes from a demand by management types that research produce clearly identifiable results within annual budget periods. The old accountability measurement has arrived for our bench scientist—and he is not prepared.

Probably the most serious charges are made by those who maintain there is excessive duplication of work caused by political considerations and poor communications. Congress is highly susceptible to individual and group pressures which

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often result in earmarked funds—a process which tends to distort carefully planned research programs.

Other observers say three-quarters of a billion dollars annually in publicly supported research should be enough to do the job—even with inflation.

The concerns coming from the private research sector (at least equal to the level of investment *vis-à-vis* public) are more understandable. Excessively high costs for transferring developed technology into merchantable product is destroying incentive.

If the investment in basic research, plus costs for registering under present regulatory controls exceed opportunity for return within a reasonable span of time, it is clear that development of new products will decline—and they have, dramatically.

Pesticides are a good illustration. The chemical divisions of several oil companies are withdrawing from manufacture presently accepted products because they are no longer profitable (zectran).

Also, EPA bans and local court decisions on several of the more persistent pesticides have further reduced materials available to farmers, not to mention sales opportunities and incentives for manufacturers (most recently, Aldrin, Dieldrin, and 2-4-5-T). USDA has contested most of these actions with only modest success so far. Local court decisions have gone both ways as scientific judgments give way to largely legal decisions. It all adds up to substantial indecision in the industry.

Somebody may have to pick up the tab for future development of alternatives to materials which are rapidly losing to environmental pressures. It looks like publicly supported research will have to bridge the gap. If true, we are back to the question of how we generate the public support needed to underwrite the need.

It is clear to some of us close to the scene that increased federal and state funds for agresearch will be unlikely for the foreseeable future. On the assumption that such an assessment is correct, a strategy must be developed at several levels to get the job accomplished.

First of all, we must start to use currently available resources at the optimum. This means stretching what we have over more workload. It may also mean better planning to divide up research commitments among the many facilities now accessible to agriculture. Multiple disciplinary teams are now a frequent method of problem solving in state and federal programs. Specialization through research centers is another way to concentrate scientific tasks and avoid or reduce the probability of needless duplication.

The regional approach adopted by ARS two years ago is beginning to have the hoped for effect of improving communications between federal and state research facilities—a promising indicator.

The Current Research Information System is becoming more useful as the versatility of the data bank increases. Scientists can now more readily determine the stage of development and location of work underway in their field—another means of reducing unnecessary duplication of effort.

One of the most promising ways of stretching research dollars is in the area of better planning and administration. For example, the National Planning Committee of the Agricultural Research Policy Advisory Committee is composed of representatives of USDA and State Agricultural Experiment Stations who are charged with the broad responsibility of promoting coordinated and cooperative research among the University Land-Grant Institutions and the federal systems. With the aid of CRIS the planning body hopes to advise its members the extent of existing research programs and to suggest regional and national priorities in agricultural research needs.

No matter how extensive current and accumulated scientific knowledge may be, it is no more effective than the degree it is directed toward solving urgent and long-term animal and plant production problems. In short, we greatly need a better system for transferring technology into useful results.

There is too often an unconscionable time lag between some scientific discoveries and public utilization.

Perhaps the difference can be traced to a misplacement—or at least an imbalance—of priorities. Perhaps we are simply putting too much emphasis on communication with potential users of the technology.

However it may be, let us look at this side.

A special report recently prepared for the National Science Foundation [1, p. 22] addresses the problem of inadequate technology transfer and utilization of public research findings. The report recommends that "the Government, in collaboration with innovators, suppliers and users, adequately define the opportunities [for quickly transferring public research into public utilization] in terms of specific needs or ultimate uses, market characteristics, economic payoff and public benefits, and match these opportunities with the available technology."

While the report recommends such federal involement as the provision for incentives and tools such as adaptive engineering, seed financing, and marketing assistance, it in no way implies that the federal government should become a competitor to the private entrepreneur.

I firmly concur. The federal role in technology transfer and utilization should be one of stimulating and assisting, not one of inhibiting the nation's industrial sector.

In short, the government can provide some of the important technology. And it does. But its rôle as a technology transfer and utilization catalyst needs considerable refinement.

Let us look at some of the things we might do to underscore our responsibility in the catalytic process. We might be able to improve the quality and quantity of technology transfer by recognizing scientists who do a particularly good job of technology transfer and implementation. At present, most promotion evaluation systems recognize only so-called "scientific" contributions of researchers—such as publications—and not the time and effort expended in working with user groups.

Such a revamping of our evaluation and promotion systems might help offset professional jealousy and protection of personal domains that exist among some scientists. Both the scientists and the public would benefit.

The Department of Agriculture could also focus more attention on its licensing of inventions. USDA's current policy is to encourage the development of its inventions to the point of practical application, including the granting of licenses. Department inventions will normally be made available to responsible applicants with licenses granted on terms and conditions considered to be most favorable to the public interest. Either nonexclusive or exclusive licenses may be issued by the Administrator of the Agricultural Research Service to processors or manufacturers who meet certain requirements.

The current policy works like this: exclusive licenses are considered appropriate when (a) the invention has not been developed substantially to the point of practical application, (b) when it is not likely to be developed to such a point by the government or by means of nonexclusive licensing, (c) when the granting of an exclusive license will substantially accelerate development of the invention, or (d) when the ARS Administrator determines that a previously granted nonexclusive license has not resulted in substantial development and that an exclusive license is necessary to bring the invention to the point of practical use by the public.

I see nothing inherently wrong with that policy. The trouble is, about the only way we have drawn attention to it is through the issuance of news releases. We must try new channels, and we will.

So far I have focused on the primary uses of technology, i.e., using public research in a narrowly-defined way to meet a specifically identified need. But let us not forget the limitless secondary uses we can get from our research—items like Teflon and the micro-wave ovens that have emerged as by-products of our space program. Some of our most useful scientific achievements have come from chance discoveries. We need to avoid putting the scientist in too limiting a role.

I earlier said that one of our problems in technology transfer can be traced to a misplacement —or at least an imbalance—of priorities. Consider this: of the nation's total research and development budget for Fiscal Year 1973, only 0.25 percent was authorized to encourage technology utilization. This does not include funds for collecting and disseminating information. This amount—only one-fourth of 1 percent of the R&D budget—was all that was allocated to stimulate substantial and profitable secondary uses of publicly-funded technology.

From these numbers the National Science Foundation [1, p. 18] reaches a basic conclusion: that the government should redirect the emphasis and correct the imbalance between merely reporting technology and actually doing something about its transfer to and utilization by the public.

One possible solution is to increase the funding for application, adaptation, and utilization to at least the same level as that expended for the collection and dissemination of information. In Fiscal Year 1973 nearly $1 billion went to the collection, organization, and dissemination of technical and descriptive information.

One billion dollars!

And that does not include the myriad of other services provided by the information personnel in the federal government.

It would seem to me that, if we cannot find the funds for more direct transfer of technology, a good place to start looking just might be in our information budgets. Perhaps we could redirect the use of a portion of that billion dollar fund that we already have.

I suggest this because the techniques generally used by federal and state agencies for transferring technology are based on passive methods: collecting, screening, indexing, storing, and disseminating scientific and technical information on the specific request of a potential user. Such methods cannot be fully effective because they depend on the prospective user's ability to define narrowly the technology he seeks. Also, the procedures used to search out the information are often complex and overlapping, and the format in which the data are provided to the requester is frequently ripe with bureaucratic superfluity.

A summary point is this: we simply cannot measure the technology transfer and utilization output only in terms of the number of people contacted, the weight of our publications, the frequency of our public relations announcements, or the thoroughness with which we complete our study contracts with universities. These yardsticks bear little relationship to the *real* impact our research tax dollars have on the public good.

Along this very line, the same report prepared for the National Science Foundation [1, *Summary*, p. i] recommends that projects for transferring and using federal technology should be funded on the basis of reasonable evidence that there will be widespread public benefit in terms of bolstering the economy and easing national problems. This kind of approach would seem consistent with the suggestion that our information collection and dissemination budgets be reevaluated.

Again, what are the dollars and sense of effective transfer and utilization of Federal technology? Consider this testimony from last year's hearings before the House Appropriations Subcommittee.

> If the agricultural output we achieved in 1970 had been produced by the methods available to farmers in 1939, it would have cost our Nation about $29 billion more in land, labor, capital, and other resources than the actual cost in 1970. Using the 1939 methods today would mean higher costs for poorer quality food.

This estimate was derived from Economic Research Service data on total inputs and production in agriculture. Farm output increased by 59 percent from 1939 to 1970—during a time (like today) with much to be desired in the effectiveness of our technology transfer. If productivity had not increased during that period, total inputs required in 1970 would have been 50 percent higher. These additional inputs—valued at 1970 costs—would have totaled $29 billion.

Specifically, what is the agricultural economist's role in this? It seems to me that the agricultural economist should be the impartial judge of critical commodity needs. He is the fulcrum. He is the focal point in the interdisciplinary activity that leads to effective transfer and utilization of our technology. He is the one who can take a close—and objective—look at our total farm production systems and advise us on how best to adopt our orphans of technology.

And, as an additional role, the agricultural economist can interpret farm production costs for the consumer. He can be the mediator—or buffer, if you will—between the producer and the consumer. If the consumer is willing to pay, say, $1.50—but not $2—for a pound of beef, the agricultural economist can bring this message back to the producer. That message would also be a challenge to the research scientist, whose job it is to transform public need into workable, practical technology. Then the economist's catalyst role takes over and we come full circle with technology utilization.

Indeed, the problems are large and imposing. And the possible solutions are complex and sometimes overlapping. The hope is that more of our technological orphans will be adopted sooner so they can be useful now. So, too, must we build a system of research accomplishment which will provide an anchor for a food industry unequaled in the world.

We can do it, and you can help.

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Economic Research and Education for Commercial Agriculture

Richard L. Kohls

First, I want to lay before you the limitations of my competence. For almost 20 years I labored, and I am biased enough to believe productively, in the vineyard of teaching and research in Agricultural Marketing. However, for almost 10 years now I have been in academic administration—six of which have been as Dean of Agriculture at Purdue.

Contrary to some faculty opinion I have found the job of being Dean to be one which requires my full energies. Therefore, I admit freely to being only observationally acquainted with much of the research and extension developments in Agricultural Economics in recent years. Rather than go through a superficial literature research effort to look highly informed, I will present my opinions and observations as they are. You will have to assess their value and validity. I would mention, however, that my recent employment gives me some perspective of research and extension problems, and I believe these are to some degree shared by other Deans of Agriculture, and Directors of Experiment Stations and Extension Services.

The Setting for Commercial Agriculture

I have become wary of making grand prognostications about what the long distant future will be like. Most futuristic predictions are fundamentally current trend extensions. But trends do change—and these critical times of changes are what predictors have difficulty in identifying. My time horizon, therefore, is quite limited—10 years at the outside. The real challenge anyway is to keep our outlook up-dated as time and events march on.

In this time frame, several things, I believe, will be happening. Without any elaborate model development, I suggest the following are major problem and situation shapers in commercial agriculture.

(1) The ancient cross of the cost/price squeeze in agriculture is not going away. In fact the results of the present and near future situation may give the seemingly chronic disease of Agriculture considerably different and virulent dimensions:

- —There will be increased possibilities of much greater price variability for agricultural products than has existed anytime in the post-World War II period. Expanding involvement in international markets and the increasing use of untraditional raw products in ever-increasing processed food products—both indicate more demand and supply variability and perhaps a change in the nature of the functions themselves.
- —Prices of the agricultural input industries will certainly not develop any such volatility. The nature of its competitive structure means increasing importance of pricing practices and marketing behavior.
- —There will be pressures for the increased use of debt financing in agricultural production, both real estate and non-real estate, which will mean still more fixed charges to be handled.

(2) Food will be of increased public concern—its supply and relative prices, its purity and heathfulness; the ethics and economic behavior of its business operators.

(3) All levels of the food business face the prospect of increased public regulations aimed at restricting the rights of private property and freedom of entrepreneurial action. The so-called free market faces great increases in bureaucratic red tape and costs.

(4) The speed of technological change may slow down. Significant technological discoveries and developments are more costly to obtain; introduction of new technology into practice will be more costly and more difficult.

(5) The food production establishment will become increasingly vulnerable to technological crises. The search for efficiency results in less variation in plant materials, animal nutrition and management, and general production management practices.

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When something goes wrong, it increasingly can go wrong in a big way!

(6) The clientele for our research and extension services will remain diverse. The "bigs" will not completely take over. In fact, schemes of running sizable farming operations in concert with other employment is a relatively permanent organizational pattern not to be confused as a route "in or out" of farming. The young and beginning farmer will be of greater importance.

The Definition of Commercial Agriculture

In the discussion here, "commercial agriculture" is broadly construed to encompass the producing farmer as well as the industries selling to him and marketing his product. It makes less sense now than in the past and will make still less in the future to deal with the food and fiber producing and marketing chain as separable components.

On the producing side "farmers" must include the "medium-sized" and "part-time" operations as well as the relatively few giants. It makes sense to sort out the "subsistence group" from this package—but that is about all.

I might, at this juncture, quickly protect myself from the criticism of all of those in agricultural economics whose activities are related to the problem of world development, community development, and resource development. These problems are important and have a rightful place in the total activities of agricultural economics. The subject of this paper, however, is limited to only one of the important segments of the profession.

The Revitalization of Policy Research and Extended Education

Agricultural economics played a major role in the basic policy issues that faced us in the immediate post-World War II years. Research tackled the fundamental issues in price supports, storage programs and land retirement proposals. Extension developed the strategy and won public approval for doing educational work in these controversial areas. In fact it does not stretch the facts to assert that agricultural economics played a major role in formulating policies that finally evolved.

For some reason research and extension efforts in the public policy arena seemed to have declined sharply in recent years. The major role of both policy research and education is to help clarify the problem issues, develop and evaluate potential alternatives for solving them. Perhaps there were no substantive issues, or the problems themselves were too obscure in the public consciousness to deserve attention.

Whatever the reason for recent inactivity, I suggest the situation has changed and the problems of public policy again are in need of the illumination that agricultural economists can give it. The present situation of agriculture and the food industry can best be described as "policy-less."

Only a very optimistic few hold that a new era of great prosperity for agriculture is here. I hope they are right, but I do not believe they are! As suggested earlier, the income problems arising from disadvantageous cost/price relationships probably will return upon the scene with renewed vigor and new dimensions. The nature of the problem has been complicated by growing international trade. The trade issue additionally is not entirely an in-house one of expanding agricultural market outlets. The U. S. economy must generate a growing source of international exchange in order to buy critical materials from abroad. In this effort the relative efficiency of agriculture is a trump card.

However, as recent events have sharply demonstrated, pursuing these markets vigorously runs head-long into the relatively cheap food for domestic consumers which has been a major result of past agricultural policy. Heavy involvement in international markets also injects a degree of income risk and uncertainty that has not been with us for 20 years. Proposals for various kinds of storage and reserve programs have already surfaced as one issue needing definitive research and educational attention.

Other socioeconomic political issues are crying for intelligent attention. Though many would not like to admit it, the behavior of our food marketing system does not fit the model of highly effective competition. The type of access to markets (both input and output) that will be available to farmers remains a critical question. The whole array of regulatory control over land use and entrepreneurial decision making cries for attention. How "free" should the market system be; how "private" should property be; how much "public protection" of individuals is in order? These questions take on the labels of land-use policy, environmental protection, consumer protection, transportation policy, and energy policy. Currently they suffer from an extreme dosage of emotionalism and over-simplification.

Frankly, considering the problems that our country seemingly faces in the whole broad range of economic policy, this may be the opportunity for agricultural economics again to lead the way. I recently read an article that was commenting on the state of the profession of economics. The comment was that the profession must be in considerable disarray, for the lack of its usually vocal reaction to important economic issues of the day was deafening! The recent fine work in pulling together appropriate educational material to focus on the question of "Who Shall Control Agriculture" demonstrated again the leadership role that agricultural economists can play. Hopefully it is just the beginning.

The Market Place Presents New Challenges

Immediately after World War II, Congress, through the Research and Marketing Act, gave a priority direction to the marketing work in agricultural research. Following normal procedures, the research establishment resisted the change in direction with predictable reaction. It first tried to redefine marketing so broadly that the additional resources could be funneled to support work already underway. (This same procedure again has been followed as Congress has attempted to emphasize rural community issues.) However, such reactions are normally temporary, and to take credit, added research and extension activity on marketing problems did evolve. Much improved knowledge about the efficiency and behavior of our marketing system was developed, and extension efforts in the area did expand in the 1950s.

Many recent developments, however, have indicated that our marketing knowledge basis has become old and fairly full of holes. Statistical series do not shed much meaningful light on market behavior—data used for measurement often appear to have inadequate bases. Much of the substantive measures of consumer demand are based on data from before the early 1960s. Analysis of advertising and demand enhancement has been largely relegated into the hands of those selling the service itself. The high cost, inefficiency, and chaos of the food transportation system has all the ingredients of a national scandal. The growing institutional markets for food usually receive only afterthought analysis and attention.

From the farm producer's standpoint, I doubt whether we can yet answer in a definitive way whether there is a substantial difference in competitive advantage among farmers of different sizes. The same reservation applies to the important question of impact upon price and output stability of the changing size structure of farm units. Extent of meaningful knowledge is limited concerning the impact of cooperatives and their activity in the modern scene.

In the language of the extension educator, teachable moments concerning food and its marketing system have been occurring recently with great frequency. Have we reacted positively to the opportunities with forward-looking, soundly-built programs which enhance the marketing understanding and knowledge of farmers, firm managers, consumers, and the general public? Unfortunately the basic educational job in this arena is never done. Each new generation of people must relearn some of the basic propositions about the nature of marketing margins, channels, producer and consumer behavior, and competition. The challenge is not only to teach effectively, but also to have something more than popular myths for content.

The Farm Firm a Continuous Challenge

If the various propositions laid out earlier are accurate observations of the future, then our research and education work with this clientele will need sharpened emphasis and attention. The fundamental conclusions for farm operators from much previous research and educational efforts can be summarized fairly succinctly: get bigger—more land—more machinery—more fertilizer—more capital. The assumption for the manager was rather narrowly confined—he should consider farming his full time occupation and his goal should be to maximize his dollar income. The market assumptions were also rather straightforward—the critical inputs such as land, equipment, fertilizer, and energy were considered available and relatively cheap, and market outlets would be available where products could be sold at the going price.

The research and education work done following this rather restricted model has been fruitful. However, a short period ago we were sharply challenged as to whether following this route served only the very large farmer and ignored the remaining farming structure. And of course, recent shortages, galloping input costs, increased uncertainty of output prices, and a whole host of other technology-restricting constraints related to land use and the general environment have posed still additional variations to the management theme. These events have sharply altered previous costs and income assumptions and levels. In the biological area it is widely acknowledged that each new technological advance reopens problems previously considered solved. I suspect that management research falls more into this same category than we like to admit and that many rather basic managerial research problems need continuous re-doing.

The extension education challenge is fully as difficult and frustrating as the research. A task force was recently assembled to address the issue of improving extension education for a growing agriculture. One of its conclusions was that the extension effort should effectively reach more of the mainstream farm producers who produce 90 percent of our food and fiber. It particularly singled out the needs of the average limited-resource and the younger farmer. This, of course, is a bigger and more diverse clientele than the large and progressive farm leaders with rather unlimited progress and growth capabilities. To serve this group of farmers effectively will require special creative effort on the part of both research and extension.

Extra effort is needed to assure that in both extension and research there is improved cooperation between the agricultural economists and the many other subject matter disciplines serving agriculture. There are increasing restrictions on how the activities of farming are to be carried out, and these have total management ramifications. New rules and regulations are continually proposed. These need the cost-and-returns analysis of economists as well as the input of the particular technology involved. Intellectual ivory towers and disciplinary jealousies have little place in the problem-solving mission of our Agricultural Experiment Station or Extension Service.

A Closing Note

From the above, it should be evident that I consider the future role of the agricultural economist in the research and education efforts with commercial agriculture to be of importance. Certainly many of the current and developing problems can be better handled if they receive constructive input from this discipline.

Will agricultural economists play an expanding role in this research and educational need? This is another and separate question. Since World War II there has been a substantial growth of agricultural research scientists in our experiment stations. However, during this time span the growth in agricultural economics personnel has been just about the same as in other disciplines. This development occurred during the time in which there was an effort on the part of Congress to expand the research effort in marketing! Why has this gap between potential and actual involvement developed? Will it change in the future? From my viewpoint the following questions hold a key to the future development.

(1) Will agricultural economics improve its cooperative relationship with the other plant, animal, and related sciences in agriculture? If I understand my history, agricultural economics split off from economics partly because of this cooperation question. It made some of its finest contributions by attacking important problems in close working relationship with agronomists, horticulturalists, animal scientists, etc. Recently there has been a tendency to turn inward and focus upon itself.

(2) Will agricultural economics re-focus its attention to bring economic analysis to solve work-a-day problems of importance to its clientele? Can the profession restrict its love affair with abstract model building and talking to itself to at least a part-time occupation? Many of the problems seeking attention are not on the periphery of knowledge. Much effort will be that of re-plowing some old ground. Other economists may not have much respect for it. But if well done, farmers, business people, consumers, citizens, and taxpayers will praise it and therefore may be willing to support it.

(3) Will agricultural economics be willing to work at effective communication with the various groups of its public? This, of course, is a question similar to the one above. Unfortunately each new generation of people has to start its learning from scratch. Economic literacy, whether it be for farmers, consumers, citizens, or environmentalists, is an acquired characteristic, not an inherited one. And most people do not fight to drink at the fountain of knowledge—they have to be persuaded. The subject matter again is basic and maybe uninspiring. But unless we

can communicate with our audiences (and incidentally also with our station and extension service directors), expanded support cannot be expected.

(4) Can we in the experiment stations and extension services of the universities become more responsive to solving short-run important problems? Such problems often require a team-of-disciplines approach. They often are not easily adaptable for use in the slow moving graduate training structure. Much of our research effort is heavily entwined with the graduate operation aimed at producing other agricultural economists. It also is usually more comfortable to work alone rather than in harness with others. However, unless we can improve in our ability to handle such problems, such work either will increasingly be funded to special research agencies, or the experiment station will have to reduce its commitment to the graduate training enterprise.

Many academicians will react to a presentation such as this in a predictable way. They will agree that there are many things needed—and many of the points raised are valid. If the dean and university administration will allocate additional funds, they will agree to get someone to do the job.

I recognize that the simplest and least painful way to adjust the activities is through the "add-on" procedure. I also have to share my firm opinion with you that this relatively painless way of allocating resources in the educational establishment has a low probability of becoming reality. Three observations are behind this conclusion.

(1) Extra resources are most easily attracted to an area because it *is* useful—not because it *can be* useful. Extra resources come most easily to demonstrated performance; it is most difficult to fund promises.

(2) There is little evidence to date that the increased public concern about the food and agricultural operation will translate itself into hard support. There has been more hot air than hard dollars to date! In fact in recent years there have been efforts at the national level to cripple severely, if not to kill, the decentralized system of state extension services and experiment stations. The extension and research system of our land-grant colleges is widely recognized abroad as one of the unique keys to our agricultural superiority. Domestically, our leadership often acts as if it believes our agricultural productivity and efficiency were automatic developments which will continue indefinitely without effort. This greatly complicates paying the bills—especially when inflation means it takes more to stay even. The shocking fact is that the total experiment station and extension program effort is probably less than in the middle sixties.

(3) The research establishment of higher education in general has lost a great deal of the public support given during the immediate post-war years. Each can develop his own explanation for this development, for there are many and varied reasons proposed for this disenchantment. Again, this situation is greatly complicated by the sharp inflation of all costs of operation.

In many ways, research and extension establishments have to practice what they know is a very difficult and often painful process for others—adjustment to stay relevant in a model of little real growth. They also must accept what they know is true for others—if adjustments are not taken, support to the enterprise diminishes still further. Even so, I am optimistic that if we contribute to the solution of important problems and work vigorously at the continuous and difficult job of effectively communicating our contributions to others, we will receive substantial long-run public support.

Session 6

ECONOMIC RESEARCH AND EDUCATION FOR COMMERCIAL AGRICULTURE

Discussants: Dale E. Butz, Illinois Agricultural Association, Bloomington, Illinois; Ludwig M. Eisgruber, Oregon State University; Olan D. Forker, Cornell University; B. H. Robinson, Clemson University

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SESSION 7

SUBSECTOR ANALYSIS—AN APPRAISAL

CHAIRMAN: GEORGE D. IRWIN, USDA-ERS, NORTH CAROLINA STATE UNIVERSITY

The Subsector as a Conceptual Framework for Guiding and Conducting Research*

BEN C. FRENCH

IN 1968 Jim Shaffer produced a set of idea-filled papers on economic research in which he suggested a need for programs of research having a "subsector" orientation [34, 35, 36]. A subsector was defined as "the vertical set of activities in the production and distribution of a closely related set of commodities" [35, p. 3]. It differs from an industry in its inclusion of all vertical components as opposed to only horizontal activities. Shaffer argued that this type of orientation was required in order to evaluate the impacts of what he called the "scientific industrialization" of the food and fiber sector. He felt that the most critical problems and issues of the food industry were associated with this process. Division of the total system into subsectors would provide more manageable units of observation and still permit consideration of the vertical relationships that were essential in evaluating coordination and performance of the industry.[1]

Shaffer's suggestion was viewed with approval and given further support at the 1968 Nebraska Seminar on Better Economic Research in the U. S. Food and Fiber Industry [50]. The following year subsector studies were recommended as a major area or program of research by the Joint USDA-SAES Task Force on A National Program of Research in Marketing and Competition [49]. Subsequently, there have been several efforts to develop this type of research orientation and it has been a much discussed topic at association meetings, seminars, and workshops—for example, see [16, 21, 23, 30, 32, 33, 51, 52, 53].

Our purpose in this session is to review experience in developing subsector studies, to examine the emerging organizational concepts and research approaches, and to appraise the future role and promise of this type of research program.

Dimensions of Subsector Research

Subsector studies mean (or have meant) different things to different people. For example, Langham and Polopolus stated that "from a theoretical point of view subsector analysis cannot be distinguished from systems analysis and does not therefore represent a new development" [21, p. 2]. This view apparently was shared by Manchester who regarded the terms "systems research" and "subsector research" as synonymous [23, p. 1]. Shaffer, on the other hand, took a broader view. He suggested that subsector studies are "more of a departure in research organization than a departure from traditional approaches of agricultural economics research." He went on to say, "Closely tied to my perception of subsector studies is what I call a systems orientation. . . . At the same time, I do not perceive subsector studies limited to particular methodologies" [37, pp. 333–334].

What emerges is a two-dimensional concept: (1) *Subsector research systems,* a way of organizing research, and (2) *subsector systems research,* a methodological approach in which a subsector is the unit of observation. We will need to keep these differences clearly in mind in evaluating the merits of subsector analysis.

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[1] For further development of the reasons for increasing concern with vertical structures and subsectors, see Hildreth, Krause, and Nelson [16].

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Subsector Research Systems

Shaffer proposed that subsector studies be done by national consortiums, which in turn would organize special task forces as needed [34, p. 4]. So far, actual organizational efforts appear to have fallen well short of the consortium concept. In fact, most published studies which focus on subsector systems (or some significant vertical component) have been developed on a more or less ad hoc basis and are widely dispersed among research agencies and researchers throughout the United States.

Probably the best known "group" effort is the hog-pork study involving ERS, Purdue University, and Michigan State University. It will be discussed in a following paper by Candler and Manchester. Another sizable effort centers in the Dairy Group of ERS in cooperation with Pennsylvania State University and with inputs from some other states. Several other ERS subsector systems studies are still largely in the planning stage. They include beef, eggs, coarse grains, and cotton [23, 43].

There are two subsector projects organized on a regional basis: SM 46 on vegetables in the South (primarily fresh tomatoes) and NC 104 on grain marketing. I probably should also note the series of special team studies on marketing applies, canning peaches, pork, eggs, and potatoes undertaken in 1972 [41, 42, 45, 46, 47]. Although sponsored by the USDA, the teams included representatives from a number of federal and state agencies.

Appraisal framework

To develop a framework for appraising these and other potential subsector organizational efforts, I drew on the stimulating book by C. West Churchman, *The Design of Inquiring Systems* [5]. Churchman suggests nine necessary conditions for something to be conceived as a system. Very briefly, a system must be goal seeking; have a measure of performance; have a client whose interests are served by the system; have components which are goal seeking and coproduce the measure of system performance; have an environment which also coproduces the measure of performance; involve a decision maker who can produce changes in the measure of system performance; and have a designer who conceptualizes the nature of the system and whose intention is to change the system to maximize its value to the client. Churchman notes finally that there must be a built-in guarantee that the designer's intention is ultimately realizable [5, p. 43].

Applying these conditions to subsector research, we obtain the following system specifications.

1. *The goals of subsector research* are a subset of the larger set of goals of economic research generally (see [48]). The particular goals of subsector studies were specified by the 1969 Joint Task Force on Marketing and Competition as: to "improve our understanding of how the subsector is now organized and functioning" and to "increase our knowledge of why and how the system is changing, what the sources of change are, and where such change is taking us" [49, p. 18]. These goals were given a more clinical focus by Shaffer who viewed the objective as "to identify barriers to improved performance and problems of participants in the subsector and attempt to identify the means to remove the barriers or solve the perceived problems" [35, p. 6].
2. *The performance* of the inquiring system should be measured by how well it serves the client's interests. Since we always begin with some prior information about the issues of concern, the appropriate measure of research system performance is the value to the client of the additional imperfect information generated by the research, evaluated in a Bayesian sense.[2] Because of the great difficulties in developing such measures, performance has been measured in practice by the collective subjective judgment of the community of scientists and research administrators.
3. *The client* consists of decision makers within the subsector economic system and people charged with making and carrying out public policies with respect to the food and fiber system.
4. *The components* are the various projects or program areas of research within the subsector framework; subcomponents are the individual researchers or research teams.
5. *The research environment* consists of the complex of laws and regulations and budgetary and social constraints plus educa-

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[2] There is a large body of literature dealing with decision making under uncertainty and the Bayesian approach to the problem of inference and decision. For illustrations relating to agriculture see Halter and Dean [14].

tional and research policies dictated by university trustees, administrators, foundations, government agencies, and legislators.

6. *The decision maker* is a team of economists and possibly other scientists and research administrators.
7. *The designer* may be the same as 6 or special planning committees, task forces, and individuals such as Shaffer.
8. The various study groups plan to develop the organization of the inquiring system to maximize its benefits to the client.
9. Condition 9 is assumed.

Examination of efforts (and non-efforts) to organize subsector inquiring systems in accordance with the above specifications reveals some significant design deficiencies. Of major concern are the client orientation, the delineation of components, the need for better research information systems, and the organization of decision-making teams.

Clients

Identification of clients is very difficult. In designing an inquiring system supported by public funds it is essential that the clients be selected so their goals are consistent with general social goals. Furthermore, to be most effective, the research plan should carefully consider how the information generated fits into the client's decision system and how it will be used. Judging from published studies, this aspect of system design deserves much greater consideration. We shall return to this point in the discussion of research methodology.

Components

There seems to be general agreement that subsector study components should be specified so they contribute to an overall conceptual model capable of analyzing problems that require consideration of the total subsector. Yet examination of some of the types of subprograms actually proposed (e.g., by the Joint Task Force on Marketing and Competition [49, pp. 19–21]), suggests a rather loose collection of studies with no clear indication of how they will tie together. The conceptualization of the whole seems to have been neglected. On the other hand, when we examine efforts to model total systems, it is often difficult to see the contributions of building block studies.

One of the reasons for this apparent disparity is the failure to distinguish clearly between subsector systems analysis and the subsector as a focal point for accumulating research results and developing a research information system. The two concepts require different component structures. Subsector systems analysis, in particular, requires that subprojects fit tightly and contribute directly to the model of the total system. Failure to maintain this distinction may lead to confusion and frustration.

Research information systems

I would not argue that all subsector research needs to be carried out by consortiums or task forces, particularly when dealing with minor commodities such as (say) brussels sprouts. However, there is certainly need for better coordination and information exchange. Even in the subsectors for which ERS has assumed some leadership, the coordination remains informal and does not extend far enough.

One means of improving the performance of the inquiring system would be to have each of the eight commodity program groups of ERS take on the responsibility of becoming national economic research information centers for their particular commodities. This is an extension of the "desk" concept first advocated by Shaffer, but apparently never taken very seriously (see [34, p. 25]). However, at the time Shaffer made his suggestions, ERS was not organized along subsector lines, so it would have been necessary to impose a new structure on top of the existing one, which might have been quite cumbersome to operate. With the new organizational structure of ERS, Shaffer's idea seems much more feasible.

The activities of these Centers would tie in very closely with what goes on now in the related organizational units. What would be added is a formal professional responsibility for each commodity group to be aware of all research and education related activities pertinent to their area. That means knowing about relevant programs and people in all universities (land grant or otherwise), in other branches of government, in various trade associations, and, to the extent possible, in private industry. Close ties of the subsector staffs with CSRS would be desirable and would provide a means of making the CRIS system [40] more effective.

The major vehicle for coordination and communication would be a set of annual reports on research in each subsector area. For example, the Dairy Group would publish an annual report on economic research in the dairy industry; the Poultry Group, a similar report on poultry research, and so on. Each report would have an appendix containing information on people, agencies, projects, special information sources, and other such data for the subsector. After the initial effort, it should not be difficult to keep the appendices up to date.

Eventually, I think this effort to develop an improved research information system would evolve into Centers which would offer substantial guidance and catalytic influence on the development of subsector study programs. This would be a useful development regardless of the conclusions we might reach about subsector studies as such. Moreover, the information center concept appears to have merit for functional areas as well, such as market development, distribution analysis, or farm inputs and finance.[3]

Teams

Another meritorious development would be the establishment of some subsector research teams (as has been previously advocated by many others), perhaps along the lines of the new NC 117 proposal on "Organization and Control of the U. S. Food Production and Distribution System." They would be interregional rather than regional in nature. A key factor would be to have most of the research team located at one place and given a reasonable period of time—perhaps 2 or 3 years—to develop the study, with provision for continuation of successful efforts. The greatest potential payoff seems likely to be in the more institutionalized subsectors. Again, this type of effort is likely to have merit regardless of our conclusions about subsector systems analysis as such.[4]

Subsector Systems Research

We turn now to the methodology of subsector studies. To provide a frame of reference, we need first to determine the kinds of questions or problems pertinent to subsector analysis. By confronting the set of problem areas with the relevant set of available modeling techniques, we may be better able to evaluate the advantages and limitations of various research approaches or mixes of approaches.

Problem definition

In an address to the Southern Agricultural Economics Association a few years ago, Bill Manley expressed concern about "the vagueness and lack of coordination in recognizing, identifying and defining research problems" [24, p. 3]. Although we may have made some progress in this regard during the past several years, it remains a point of concern. What often seems to be lacking is a clear specification of the instruments of change to be considered, the range of choice open to decision makers, and the performance measures that can be generated by the research process. Bearing this in mind, it seems to me that most reasearchable issues pertaining to subsectors involve determining how various measures of system performance are affected by instruments of change falling in one or another of six classes, as shown in Table 1.

In the examples column, groups 1, 2, 4, and 5 list things about which decisions are made within the system and groups 3 and 6, things which act on the system. This is the familiar distinction between endogenous and exogenous variables and is subject to some change, depending on the specification of the system. Classes 1 and 2 may overlap. The main difference is that 1 is concerned with conscious efforts to redesign the subsector system while class 2 traces (or projects) the impacts of evolving changes in the system.

The column of performance measures lists the kinds of information our economic research seems capable of generating. For decision purposes, these measures need to be related to broader social goals such as efficiency, progressiveness, equity, and other values. Success in quantifying these relationships has so far been limited.[5]

Research approaches

Although Shaffer indicated that he did not perceive subsector studies limited to particular methodologies, it is possible to identify a particular set of models or approaches that have been used or advocated for subsector analysis. I have grouped these into four qualitative and four quantitative classes.[6] Brief descriptions and examples follow.

A. Qualitative or descriptive studies.
   1. *Base studies:* Include efforts to identify problems, describe subsector activities, and pull together what is known about

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[3] For additional development of these ideas see French [10].

[4] For further discussion of the benefits of group research, see Henderson, Bell, and Perkins [15].

[5] For discussion of such measures, see Marion and Handy [27].

[6] This distinction is not strictly accurate since qualitative models may rely on various kinds of data. However, the qualitative approaches do not use formal systems' models.

Table 1. A classification of research issues for subsector analysis

Instrument of Change		Primary Performance Measures
General Class	Examples	
1. System design	Size, number, location of plants at different vertical levels; scheduling and coordination systems for flows of activities and materials.	Costs, output, concentration.
2. Technology, business practice	Innovations, ownership patterns, corporate or cooperative structures.	Costs, prices, plant locations, plant size, employment, output, firm growth, stability of outputs and returns.
3. Regulations	Taxes, pollution, use of chemicals, insecticides, drugs, anti-trust, safety, property rules.	Costs, prices, output, plant size, locations of activities.
4. Production and marketing controls	Market order provisions, supply controls, grades and standards, administered pricing programs.	Prices, output, costs, distribution of returns, price and return variability, concentration.
5. Transfer arrangements	Contracts, bargaining, information systems, other transaction systems.	Prices to participant groups, costs, market concentration, profits, stability of prices and returns.
6. Demand parameters and inputs markets	Shifts in tastes, substitutes, export markets, socioeconomic factors, input prices and availability, transportation costs.	Prices, outputs.

the parameters of the system. Examples: Southern rice industry [11]; pork industry [32]; dairy industry [44]; beef industry [39].

2. *Analogous experience:* Proposed by Hildreth, Krause, and Nelson [16]. The idea is to generalize for one subsector from an in-depth appraisal to another. Previous applications unknown.
3. *Delphi approach:* Also suggested by Hildreth, Krause, and Nelson [16]. It involves bringing a range of expert opinion to bear on the issues of concern. Examples: Marketing team studies on apples [41]; canning peaches [42]; eggs [45]; pork [46]; potatoes [47].
4. *Systems analytic description:* Close to base models. It examines the subsector in depth within a systems taxonomy. From this an effort is made to identify forces of change and to suggest desirable adjustments (the Harvard Business School approach). See Goldberg [12], wheat, soybeans, oranges; Arthur, Houck, and Beckford [1], bananas; Marion and Arthur [26], broilers; Morrissy [29], fruits and vegetables.

B. Quantitative models.

1. *Design models:* Show how the subsector system (or some significant part) might be reorganized to reduce costs and increase profits. Linear and non-linear programming are the major tools. They include optimum number, size, and location models for plants and activities (overlapping area efficiency and interregional competition models) and coordination models which determine when and in what quantities and qualities products should be procured, produced, and sold in an integrated system. Examples: Holder, Shaw, and Snyder [17], rice; Leath and Blakley [22], grain; Bell *et al.* [4], fertilizer; Snyder and Candler [38], hogs; Belden and Schrader [3], turkeys.
2. *Comparative static models:* Show equilibrium positions of industries before and after varying one of the instruments of change (see Baumol [2]). Previous subsector applications are unknown.
3. *Dynamic econometric models:* Market oriented supply-demand models of commodity systems for which parameters are estimated by econometric (stochastic) methods. Examples: Hallberg [13] (in progress), dairy; French and Matsumoto [9], brussels sprouts; Crom [6], beef and

pork; Rausser [31], oranges; Houck, Ryan, and Subotnik [18], soybeans; Mann [25], tobacco. For additional references see Johnson and Rausser [19].

4. *General systems simulation:* Distinguished from econometric simulation by its greater detail and flexible approach to estimating parameters of the equations of the system.[7] There are many variants, including micro-dynamic models (still rare) which may simulate behavior of individual decision units in modeling the total system. For references see Johnson and Rausser [19]. Examples of micro-dynamic models are Duewer and Maki [8], meat products, and Desai [7], dairy industry.

Evaluation of approaches

Table 2 suggests the range of applicability of the several research approaches to the six problem areas outlined in Table 1. The exact placement of the X's might be disputed. For example, design models (B1) might show how an optimal system would be affected by instruments of change in classes 2, 3, 4, 5, and 6. However, this has so far not been a primary application of these models. In any case, it is clearly evident that there are several ways to approach most of the economic issues pertaining to subsectors. I shall comment briefly on the strengths and limitations of these alternative methods as they relate to the issue classes in Table 1.

Base studies are applicable to all classes of issues. A thorough understanding of the system is an obvious requisite for further analytical models. This phase of subsector work seems fairly well developed. The problem is that we often have difficulty in moving on into quantitative synthesis.

Delphi and systems analytic approaches may be particularly useful where the time requirement for obtaining results does not permit the development of quantitative models or where we simply are unable to estimate such models. Based on the applications to date, the Delphi approach seems better adapted to problem definition than solutions. The systems analytic approach applies a more rigorous qualitative framework and seems worthy of further development. One of its limitations, at least in the studies cited above, is the difficulty in sorting out the analytical conclusions.

Table 2. Applicability of research approaches to problem areas

Problem	Research Approach							
Area	A1	A2	A3	A4	B1	B2	B3	B4
1	X				X			
2	X	X	X	X		X		X
3	X	X	X	X		X	X	X
4	X	X	X	X			X	X
5	X	X	X	X				X
6	X			?		X	X	X

The possible uses of *analogous experience* seem fairly limited.

The state of *design model* development is well advanced. We have the capacity to provide generally good measures of potential gains from improved coordination, location, size, and number of facilities in centralized marketing systems. The research information may also provide indicators of possible incentives for integration or other organizational changes in the subsector. The problem with many of these studies is that they do not have clearly specified clients with the power to implement the study findings. Such studies cannot have much impact.

With the development of dynamics and simulation, *comparative statics* seems to have fallen into disuse. However, in view of the problem encountered in measuring many types of behavioral parameters in dynamic models, perhaps we should not bury it yet. In particular, it may be a useful way to evaluate shifts due to new innovations or changes in demand parameters. In cases where dynamic models yield highly uncertain time paths, comparative statics may still provide an indication of the likely final impact.

Dynamic econometric models seem most suited to issues in classes 3, 4, and 6 and might be a part of the framework of 5. Probably more effort has gone into this type of subsector study than any other. Measured in terms of our ability to predict beyond the range of historical observation, the results have so far been considerably less than spectacular. While there remains much that might be done by imaginative conceptualization and measurement, the potential of this approach is greatly limited by inadequate or nonexistent data. The data situation becomes even more crucial as we focus on higher vertical components of the subsector. With the exception of some highly restricted retail and wholesale price series, no agency collects and tabulates price and quantity data beyond the first handler on a systematic scientific basis. We clearly need to develop new and better data sources for prices, costs, and product movements throughout the system.

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[7] For a comparison of econometric and general simulation approaches, see [28, pp. 17–37].

General systems simulation is probably what most people have in mind when they refer to subsector systems analysis. Yet I am unaware of any operational applications of general systems simulation to subsectors. By "operational" I mean a model completed, tested, applied, and found useful. The most extensive application in agriculture is the Michigan State University sector modeling effort in Nigeria and Korea [20, 28]. This might be viewed as potentially an excellent approach for subsector analysis. There are, however, several points to keep in mind in transferring this experience.

First, this type of study is very costly. The MSU simulation team estimates that with a conceptual framework already available, the cost of modeling a developing country about the size and complexity of Nigeria would be about $300,000 (in 1970 dollars) plus the cost of continued operation [28, p. 348]. Costs for modeling a major U. S. subsector could be higher.

Second, the MSU studies were developed for a clearly defined client (government planners) to fulfill a felt need for information to aid in making specific policy decisions. They were able to interact with their clients and to obtain their support (or at least avoid barriers) in seeking needed information. These conditions obtain to a much lesser degree in most U. S. subsectors.

Finally, although the MSU studies are very well conceptualized, many parameter estimates are subject to considerable uncertainty, a problem not likely to be avoided in similar studies of U. S. subsectors. The behavioral and competitive parameters which Shaffer felt were so important have proved especially difficult to quantify and to test. At this point our capacity to conceptualize and computerize greatly exceeds our capacity to measure.

In view of the variety of issues pertaining to subsectors and the limitations and special characteristics of the possible research methods and approaches, it is clear that there is no such thing as "subsector methodology." Furthermore, although all of the approaches described focus on total systems, it does not seem appropriate to regard subsector analysis as identical with systems analysis, except under an extremely broad and aggregative definition of systems analysis. The research method must be selected in accordance with the demands of the problem (or expected set of problems), the time available, the prior information and data available, and the special interests and talents of the researchers.

Future Role and Promise

Most of the previous discussion has been an elaboration and systems specification of Shaffer's concept of subsector studies. Although several weaknesses were noted in the design characteristics and the methodology of actual subsector research efforts, nothing has been said that would invalidate the concept itself. The issue for the future is not whether subsector studies may be needed, but the importance and place of such studies among other research programs pertaining to the food and fiber sector and how we organize to conduct them.

Many problems associated with subsectors, perhaps most, do not require that we deal with the full array of vertical subsystems. And as we move higher in the vertical system, it becomes increasingly difficult to maintain a meaningful commodity separation. Moreover, the 50 or so subsectors into which the food and fiber sector might be partitioned vary widely in importance, in institutional structures, and in their potential as objects of useful economic research. The result is that although much of our research needs to be systems oriented, to include vertical structures, and to relate to particular commodities, the dominant focus seems likely to be on issues rather than commodity subsectors as such.

The major benefits of a subsector framework seem likely to derive from its role as a focal point for the accumulation of research results and the structuring of research information systems. This type of coordinating orientation may reveal holes and duplication of effort, lead to improved planning, and have a general synergistic effect on research pertaining to the subsector.

As a final point, I would stress the fact that I am not suggesting we abandon efforts to develop useful models of total subsectors. However, we should recognize that much of the quantitative analysis in this area is still in a pioneering stage that might best be viewed partially in the context of basic or perhaps "intermediate" research. Judging future performance in terms only of the past record or some expectation of early accomplishment may prove disappointing and lead to premature rejection of some potentially useful approaches.

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Hog Pork Subsector Study in Review: Research and Administrative Experience*

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BEN FRENCH has discussed subsector research on a broad scale. We are discussing one particular effort which carried this label. In order for the reader to put this particular effort into context, we need to go back and sketch the outline of how it came into being.

As a result of Shaffer's paper and the Lincoln seminar in 1968, which French has reviewed, considerable interest in the discussion of the idea of subsector research was generated, both in ERS and the colleges. The ERS Administrator's office employed George Brandow of Pennsylvania State University under a cooperative agreement to outline a proposal for subsector research in one industry. In large part because of Brandow's interest, the hog-pork industry was selected.

Brandow's proposal was for a fairly narrowly-defined and tightly-structured study of the costs involved in the hog-pork subsector from farrowing to slaughter [2]. It involved a comparison of these costs under the free market and various forms of integration.

Shortly thereafter, a meeting was called of Department heads from approximately 10 hog-producing states and representatives from ERS. This group expressed considerable interest in participating in a pioneering effort to carry out subsector research in the hog-pork industry. However, there was a general feeling in the group that Brandow's proposal was somewhat too narrow. A committee was appointed under the chairmanship of Wilfred Candler of Purdue University and included George Brandow, Richard Crom, ERS, and Lehman Fletcher, Iowa State. They submitted a "Proposed Hog Industry Subsector Research Program" in July 1969.

This proposal envisioned a comprehensive research program on the economics of hog production and pork marketing. It included many more aspects of hog production and marketing than were included in the Brandow proposal.

At this point the present authors were appointed co-leaders of the study. In September 1969 they visited most of the states which had expressed an interest to explain the nature of the research envisioned and to obtain expressions of interest from them. Eight states (Illinois, Iowa, Michigan, Minnesota, Missouri, Purdue, Texas, and Wisconsin) indicated an interest. It then became evident that funds were not available to support research on this scale. The concept of a comprehensive research program in the economics of hog production and pork marketing was scaled down. The proposal which was approved in February 1970 was for a much more limited but still quite broad effort which involved approximately 10 scientific man-years plus a substantial number of graduate students. The number of participating parties was reduced substantially (Purdue, Michigan State, and ERS) to fit the resources available. Research got underway July 1, 1970, and is scheduled for completion in 1974.

Output

This paper is not designed to report the research results from the Hog-Pork Subsector Study. Rather, it is designed to report on research and administrative experience in trying to "lead" this particular subsector study, particularly with respect to the question: should more of our research be organized as subsector studies? A cursory review of the output of the project is necessary, however, if the reader is to understand what the authors think was, and was not, achieved.

Major "lumps" of output from the project can be identified, by principal workers, as:

Schneideau and Duewer:	National Symposium on Pork Coordination [14].
Babb and Frahm:	Behavioral Research on Attitudes of Farmers, Feed Firms, and Packers to Contracting Features [1, 7, 8].
Bursch and Hayenga:	Survey of Farmers', Feed Firms', and Packers' Attitudes to Contracting Integration [3, 4, 10].
Crom, Duewer, Sullivan, Liu, Vincent:	National Macro-Disaggregated Simulator of Hog Pork Subsector [5].

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* These views are those of the authors and do not necessarily reflect those of their employers.

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Snyder and Candler:	Short Term Coordination Model of Hog Pork Subsector [15, 16, 17, 18].
Kennedy and Candler:	Simulation Model of Hog Pork Stabilization Schemes [6, 11, 12, 13].
Crom and Vincent:	Simulation of Alternative Coordination Strategies at the National Macro-Level.

This is not by any means an exhaustive list of the work carried out under the subsector study, but it does give an adequate feel for the "lumpiness" of the research carried out, the apparent lack of evident interface, and the people with major responsibility for particular topics. We certainly did not get a smooth, continuous, seamless study of the subsector.

On the other hand, the National Symposium and the studies of farmer attitudes did give us a fairly clear indication that "integration" was not likely to become a hot political issue in the Midwest in the immediate future (immediate past at this writing). The attitude of successful Midwest hog producers was that they were not afraid of competition from large organizations; that they would consider contract offers on their merits; and if these offers held realistic promise of higher incomes, they would sign. At the same time, Midwest hog producers were extremely skeptical as to whether any integrator would be able to offer this type of contract.

The studies of Bursch and Hayenga showed a markedly different managerial attitude between Midwest and Southwest hog producers. There are producers in the fringe areas who are ready to, and know how to, delegate managerial authority. There are very few Midwest farmers who know how to do this. Thus the existing Midwest hog industry does not appear to be a fertile ground for integrated production.[1]

Jim Snyder's work has produced a "research utility" in the sense of an *easily used* computer model which permits a reasonable profile of retail sales to be "connected" to a profile of available hogs. This is at the research level, so that there is considerable aggregation within the model. Nevertheless, it permits a much less aggregated approach to the study of "quality" of pork products and the "value" of hogs than has previously been available.

George Kennedy's work produced a simulator capable of reproducing the impact of various pork price stabilization policies over the last 15 years (or such other price-quantity profile a researcher might wish to specify). It is, of course, necessary for the researcher to specify supply and demand elasticities, in order to use this model, but given these assumptions (or a range of assumptions) the model can investigate a wide range of stabilization policies operating at the producer or consumer level.

Policy Issues

Since inception of the subsector study, we would nominate three policy issues which have been important. The first issue was foreseen, but did not emerge as a felt problem, while the other two were not foreseen, but did arise.

The issue which we foresaw concerned a rapid increase in integrated hog production, with a loss of managerial control by integrated producers and/or a downward pressure on incomes of unintegrated producers. This issue failed to arise. Our studies showed that it was unlikely to arise as a major issue within the Midwest. Due to budget limitations we had, in any case, decided not to attempt any in-depth study of interregional competition.

The issues which overtook us were:

(a) The Degree and Form of Competition Existing in the Subsector, and
(b) Price Control for Pork Products.

The competitiveness of the subsector was studied by a USDA Marketing Team under the leadership of Jack Armstrong. This Marketing Team concluded that there were inadequate premiums for "quality" and advocated competitive arrangements based on producers versus packers, and presumably packers versus retailers.

Results from the subsector study suggested two things:

(a) From Jim Snyder's work that any underpayment for quality was relatively slight, and
(b) From Em Babb and Bob Schneideau's work that there was a quite different way of looking at competition, i.e., as between one hog-pork subsystem and another—retailers, packers, and farmers working as a team optimizing their decision for the benefit of the system as a whole, and com-

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[1] One exception should be noted. The fellow who commutes from a small farm to work, and runs a few hogs on the side, is a candidate for "integration." Many of these people would be very glad to have an integrator assume managerial responsibility for supply of feeders, sale of finished hogs, supplies of feed, and credit arrangements. This is one small sliver of the Midwest industry which is ripe for integration, because it suits this type of part-time farmer to sell principally labor and facilities.

peting at the retail counter with other retailer-packer-producer teams.

We take some satisfaction in the fact that these conclusions were available from the subsector analysis at the time of the Marketing Team study although they were not fully incorporated into its thinking (more on that later).

On the second topic, price control, we again had an analytical tool available from the subsector study, at the time that decisions on pork price controls were being taken. Again, unfortunately, it was not fully incorporated into the policy decision on price controls. Since it was almost entirely a political decision, perhaps we should not be too surprised. On the other hand, the eventual decision to remove price ceilings on pork may owe something to analyses such as this.

Managerial Input

Each individual project had its own peculiar managerial features. Some such as the Babb-Frahm and Kennedy-Candler studies were standard major professor-graduate student efforts. Others such as Bursch-Hayenga, Crom and team, and Schneideau-Duewer proceeded with less direct managerial input once the decision to go ahead had been taken.

There are three areas where the management of the subsector research probably differed from more traditional forms of research management:

(a) *Funding:* After the rather traumatic period of getting the subsector study financed, we believe the individual research workers found access to funds within the project to be easier and more direct than the normal approach to funding. This is because the funds were already earmarked for the subsector study, and a verbal commitment to (or discouragement of) a project could be obtained essentially instantly. A written proposal and budget was still needed, but this followed a verbal discussion of the need for and scope of the project. The proposal did not need to be written to convince the decision maker, rather to confirm verbal agreement which had already been reached.

This was particularly clear in the case of the National Symposium, where publication of the proceedings, honoraria, etc., were agreed to with very little formality, thus leaving Bob Schneideau and Larry Duewer to get on with organization of the symposium itself. The conception of the usefulness of a symposium, the desire to publish proceedings, and the knowledge that funding would be available were essentially simultaneous. This is totally different from having to write a proposal, send it to, say, Washington, and wait an unknown time to find out if it will be financed.

This same "quick response" is available in principle via traditional methods of research management. If funds are available, a researcher knows who can decide to fund the project, and if the administrator and researcher are enthusiastic about the project, then the availability, in principle, of funding could be agreed over the phone (leaving the "proposal" as a confirmation of the phone conversation). In practice, research administration does not often work this way, particularly in the universities.

(b) *Coaxing:* Particularly in Jim Snyder's coordination model, but also with other projects, there was an element of "coaxing" which is not usually a feature of research management. This took many forms, but, for instance, there were many times when an informal review of the status of the project was initiated by management rather than the researcher. On occasion these reviews would verify resource bottlenecks that the researcher had been subconsciously aware of (i.e., before the review the research worker would know he had to do something about x. After the review, we would have decided what we were going to do about x. If the project needed, for instance, extra technical backup, this is *not* something that the researcher can resolve alone. It is not only the availability of funds, but also who is available, whether they can be shared, etc.).

Similarly, questions arise on what degree of abstraction would be acceptable, exactly what policy questions the study may be expected to address, and so on. These are questions the researcher could resolve in isolation, but he would have little confidence he was solving them "correctly." After this type of informal review, the researcher should be confident of the direction his study should take for the next few weeks, and with any resource bottlenecks clearly identified, and hopefully, resolved.

We do not think this informal review process typically takes place within traditionally-managed research projects.

(c) *Interest:* We would claim to have been successful in giving researchers an interested and critical audience for project discussion in their formative stages.

In any research project there are innumerable options and alternatives. It is very helpful to a researcher to be able to discuss these alternatives with an interested and informed audience. A number of these discussions were organized within the subsector project. We were able to discuss the relative importance of focusing on quality versus alternative production technologies, versus attention to timing of production/marketing decisions.

We believe that these three research management features are attainable within traditional approaches to research management. To attain them, however, would require changes in current administrative practice and expectations. The most important change concerns the relationship of research to policy.

Policy Considerations

In one area we were particularly unsuccessful in the subsector project—namely in getting our research findings and capabilities integrated into the policy-making process. We failed to influence the Pork Marketing Team report on competition within the subsector, and we failed to influence the decision to control the price of retail pork products. This was not because we had nothing to say and was not because the relevant policymakers were unaware of our existence. To be completely frank, I think it was because decision makers:

(a) did not expect us, as researchers, to have anything useful to say, and
(b) had not been involved in formulation of our research priorities and approach.

This policy failure is not unique to the subsector approach, rather it is characteristic of much research of the USDA-Land Grant College system.

This is not to argue that research never affects policy, merely to say that too little research is directed to a felt or anticipated policy need and too little of the relevant research is in fact used.

This leads back to a reconsideration of Jim Shaffer's review of the first 20 years of marketing research and his suggestion that a subsector approach would lead to a marked improvement in research productivity.

First, let us enter the caveat that one experience of a so-called subsector study cannot disprove Jim's hypothesis. He presumably meant a *well managed* subsector study; and by "subsector study" he likely had some particular types of methodology in mind. The evidence from the hog-pork subsector study is only relevant to the authors' peculiar management style and the types of work we have been able to elicit under the rubric of a subsector study. If the reader likes what we have done, he can say that Jim had a point. If he does not like it, he can say the authors messed up a good idea.

Second, let us address the question, "Are subsector studies a sufficient or even a necessary condition for improved (marketing) research productivity?" After four years experience with a subsector study, and rather belatedly, the authors would answer "no." We would say that the necessary and sufficient condition for improved (marketing) research productivity within the USDA-Land Grant College System is *a fundamental and constant interaction with policymakers.*

It may well be that the *result* of this interaction is an increased emphasis on large-scale "system-oriented" studies, of a type Jim Shaffer might describe as subsector studies: but this is very different from initiating a "subsector study," as we did more or less as we now perceive, *in vacuo.* The mandate as to the policy questions to be addressed was less explicit than it seemed and, when faced with choices of emphasis, we did not have access to potential research users who could help us make these choices. We were expected, throughout, to use "our own good judgment."

To use a simile, which may or may not be due to Jim Shaffer, the first 20 years of marketing research can be likened to a pile of bricks, each a sound building component in its own way, but not arranged in such a way as to be additive, or form a building. The subsector approach may be likened to an attempt to ensure that the bricks are arranged in such a fashion as to constitute a building. Now, what we find is that it is important that policymakers want to use the building, since a building without tenants is really very little more use than a pile of bricks.

If we are right in this diagnosis, a number of suggestions could be made for increased inputs of researchers in the formulation of U. S. agricultural policy. These suggestions would, however, take us rather beyond the intended scope of this paper.

Getting Started

Ex post the frustrations of the period when we attempted (with the assistance of Dick Crom, Lee Fletcher, and George Brandow) to get the subsector study started can now be seen in part as the result of asking, "How to do better research?" rather than, "How to make better policy?"

This meant that there was a lack of focus on what the results of the study were to be used for (and hence what methodology would be most appropriate). In addition, when we came down to the funding question, it became evident that we did not have the demand for a full-scale study of the subsector which we had been discussing.

A Learning Experience

In defense of the premise that we may have learned something in the course of the hog-pork subsector, let us describe briefly how another effort involving one of us approached a somewhat similar problem in another subsector.[2] This experience says something more about the relationship between research and policymaking.

We set out to construct a systems model of the dairy industry which would be useful in answering a broad range of policy questions, although certainly not all possible questions. This is not intended to be a comprehensive research program covering all aspects of the subsector. The nature of the pricing system in the dairy industry obviously strongly conditions the kind of model one builds. Unlike the hog-pork subsector, the chief policy variables have a strong flavor of Government participation in the pricing process.

The ideal, of course, would be to build a single model including all policy variables—and perhaps this is a goal toward which to work. However, we suspect it is both wishful thinking and unnecessary in most instances. In the first place the resulting model is likely to be so large as to be unnecessarily unwieldy even on modern-day computers. Furthermore, once the basic structural system which includes a few major policy variables is solved, we see no reason why other policy variables cannot be examined via "side analyses." For example, in the dairy model we may be particularly interested in returns from dairy farming by regions and by size of farm. But this information can be derived from a model that is solved independently of the basic price-allocation model. How much of this can be done will depend to a large extent on the nature of the model as conceived—i.e., its recursive versus its interdependent nature.

Models with which to conduct these "side-analyses" may be constructed by different individuals or teams. Nevertheless this work must be coordinated so that eventually all such models can be tied together in a meaningful way and so that trade-offs between competing performance indicators can be realistically examined.

We seldom have enough information to cope with all details in the initial stages of model-building—a lesson we learned painfully in the hog-pork subsector. Some details will only be learned as we become more familiar with the data and as we conduct experiments with the model. For example, what is the appropriate level of spatial and product aggregation or what is the appropriate functional form for the demand equations? How much detail should be ignored because it is empirically intractable or would not warrant the expense of including it?

A sensible procedure seems to be to begin with a relatively simple model, then add more detail at later stages. In the dairy effort, for example, we have begun with a basic supply-demand model which has sufficient constraints built in to approximate reality in a broad or macro sense. It has limited normative capabilities and by no means includes all policy or instrument variables.

There are several advantages in operating in this fashion. First, it assures that a model is developed and available at all times—it will not answer all of the questions we may like to ask it nor will it answer these questions as precisely as we would like but it is available for generating a limited amount of information in response to some policy questions. Furthermore, it is available so that administrators can view some accomplishment—a not unimportant consideration since what we are talking about is not a short-run research project.

Second, by starting with a relatively simple model and progressing to more complicated ones, we are not as apt to lose sight of the trees for the forest. This has two dimensions—model construction and model testing. Every effort must be made to see that all components of the model are sufficiently detailed and constructed so they are related in a logical and consistent manner. Also, we are likely to find it to our advantage to be able to test out each component of the system on progressively more complex models.

Finally, by progressing in this manner, we will force ourselves to build the model in such a way that it can easily be added onto, revised, and updated. Model formulation is critical but not independent of refinement and testing. Models must be subjected to whatever tests are available to guard against internal inconsistencies or logical errors.

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[2] For a more eloquent and comprehensive discussion of this endeavor, see [9]. It should be unnecessary to say that this section draws heavily on that paper without benefit of quotation marks. A heavy debt to Milt Hallberg for these words and ideas is acknowledged.

Concluding Remarks

In retrospect, we do not wish to argue that a whole new level of research sophistication has been achieved in the hog-pork subsector research—but we do wish to argue that more real question-answering capacity was produced than has been used to date. This, unfortunately, is not new, nor is it an exclusive characteristic of subsector research. It does suggest to us, however, that Jim Shaffer's original critique of the first 20 years of marketing research should have been even more critical than it was. To paraphrase Jim's criticism, he said in effect, "if you want to build a building, it doesn't help much to make bricks," i.e., "there has to be some way of fitting the bricks together to get the synergistics of a building." Five years later we would add, "what is more, there is no point in building a building (or baking a brick) unless someone wants to use it."

There is no doubt the research output from the project was lumpy. It is easiest to think of it initially in terms of Jim Shaffer's brick analogy. Whether it is/was capable of being assembled into a building, we do not know currently since it has not been tested. Why not? Well, what problem do you want answered?

In general we believe that the diversion from actual research of two people to supervise, or oversee, the subsector work, was productive. Some of the original uncertainty as to the scale of the project and subsequent funding problems provided a real test of the flexibility which can be obtained within large research projects.

As indicated earlier, one suggestion would be a much closer relationship of research and policy than has been customary in the U. S. in the past. Even if this suggestion is rejected, we believe that some of our experiences with the subsector study can be used to make constructive suggestions:

There were two aspects of management of the subsector work which we believe differ from usual practice, though they could easily be arranged, for:

(a) The authors had a general overview of the work being conducted on the subsector (whether covered formally by subsector money or financed independently); and

(b) a number of *ad hoc* one-day meetings were arranged for researchers to discuss research proposals. Thus the interaction among researchers which is so often talked of in theory, was actually carried out in practice.

We believe, therefore, that it would be helpful if ERS nominated people to be responsible for keeping up with research in fairly general areas (subsector if you like), along the lines of Ben French's proposal for Economic Research Information Centers; that research grant/contract recipients agree to make themselves available for *ad hoc* seminars, and travel money be budgeted for these seminars; and that the research monitor be responsible for organizing seminars to consider proposals and in progress research as seems appropriate, on an *ad hoc* basis. Our seminars were held irregularly with a changing cast. The topic being considered should determine the participants.

Two somewhat different sets of interests provided motivation for the hog-pork subsector research effort. There was an interest in the idea of an integrated study of the entire hog production-pork marketing complex. Another set of interests were more organizational—how to organize several different institutions to carry out such a large-scale study. The latter reflects the general despair with regional research committees as an organizing device for anything other than surveys and seminars.

Whether one's answer to the question should then be more subsector studies obviously depends on which of the motives above attracts your attention. We are rather strongly of the opinion that there should be many more systems analytical studies of various subsectors. We are not particularly fond of the proposition that our collective experience with the hog-pork subsector provides a model for future organizational efforts in large-scale research.

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Session 7

SUBSECTOR ANALYSIS—AN APPRAÎSAL

Discussants: J. Bruce Bullock, North Carolina State University; Donald E. Farris, Texas A&M University; Charles E. French, Purdue University; James D. Shaffer, Michigan State University

Session 8

MARINE ECONOMICS: PRODUCTION AND MARKETING OF SEAFOOD PRODUCTS

CHAIRMAN: FRED J. PROCHASKA, UNIVERSITY OF FLORIDA

Food from the Sea: An Economic Perspective of the Seafood Market

RICHARD MARASCO

FOOD FROM THE SEA has been sought by man since primitive times. In ancient Egypt fish even served as a medium of exchange. It is recorded that the Union Grave Diggers in Egypt, in the 29th year of Ramses III, filed a petition with royal authorities requesting as part of their wages larger quantities of fish, the indispensable food [18, p. 41]. While fish are still an important source of protein, the potential is considered to exist for further expansion in use. Estimates indicate that fish could provide about 70 percent of the animal protein requirement of the present world population [9, p. 7].

The importance of fish in diets varies considerably throughout the world. The average American uses only about one-seventh the fish consumed by the average Japanese. To facilitate meeting the dietary needs of American consumers, fish are made available in fresh, frozen, canned, and cured forms. Seafood, irrespective of product form, moves through several market levels before it reaches consumers, the ultimate prime-movers in the process.

The objective of this paper is to provide an economic perspective of the U. S. seafood market. Examined are relative and absolute consumption and prices, demand, supply, and marketing system, and the future position of seafood in the U. S. food basket.

Relative and Absolute Consumption and Prices

Historically, meat, poultry, and fish have occupied important positions in the diet of U. S. consumers. Data published by the USDA [19, p. 16] indicate that civilian per capita consumption of all three of these sources of protein increased between 1960 and 1971. Meat consumption increased from 160.9 to 191.8 pounds per capita, while poultry, chicken and turkey, and fish consumption increased from 34.1 to 49.9 and 10.3 to 11.4 pounds per capita, respectively.[1] Therefore, these data indicate that between 1960 and 1971 per capita consumption of fish decreased relative to meat and poultry. Data for more recent years indicate a trend reversal in relative fish consumption. Between 1971 and 1972 the consumption of meat decreased to 188.9 pounds per capita. Meat consumption plunged down further in 1973 to 175.0 pounds per capita. Poultry consumption increased to 52 pounds per capita in 1972, but decreased by 1.6 pounds in 1973. Consumption of fish reached 12.2 pounds per capita in 1972 and decreased only one tenth of a pound in 1973.

Retail food price indexes constructed by the USDA [19, p. 31] indicate that the prices of meat, poultry, and fish have all risen since 1960, with sharp increases occurring in the last several years. Relative movements between the price of meat and fish do not exhibit a clear trend for the years 1967 through 1973. Since 1971, however, the price of meat has increased relative to the price of fish. Between 1967 and 1972 the price of fish increased relative to the price of poultry. This trend ended in 1973 with the price of poultry increasing relative to the price of fish.

Consumer Demand

A number of studies have examined factors that influence consumer demand for fish. For example, individual fish commodities such as shrimp, oysters, clams, halibut, and cod have

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[1] Per capita consumption is given in primary distribution weight.

been subject to investigation.[2] A characteristic of these efforts is the treatment of demand from a single commodity or sector perspective. That is, these studies do not consider the complete interdependent nature of demand. The studies of Brandow [3] and George and King [7] investigated aggregate demand for fish recognizing the interrelationships among all food commodities.

In addition to analyzing the effects of prices and income on the quantity consumed, it is also necessary to determine the effects of psychological, sociological, cultural, and regional factors.

Own price

The landings, processor, and retail markets constitute the most important market levels in the fishing industry. Each one of these three market levels serves as a link in a chain of institutions affecting the marketing process. Prices at each of these levels are linked by marketing charges. In the whole process consumers serve as the prime-movers. Since it is the retailer that faces consumer demand, it is the relationship that exists between price and quantity at this level that will be evaluated.

Price elasticities of demand for fish reported by Waugh and Norton [21], Brandow [3], and George and King [7] provide examples of empirical elasticities which have been estimated. Waugh and Norton, using the single commodity or sector approach, obtained an elasticity of —0.37. Price elasticities of —0.65 and —0.23 were reported by Brandow and by George and King. Thus, these estimates serve to indicate that the demand for fish at the retail level is quite inelastic. Both George and King, and Brandow found the demand for fish to be more inelastic than the demands for beef, veal, pork, lamb, chicken, and turkey.

Comparison of the price elasticities of demand for finfish versus shellfish is not possible because of the lack of elasticity estimates at this level of aggregation. It is possible, however, to make comparisons among species. The demand equations developed by Bell *et al.* [2] for use in their forecasting study indicate that the demand for shrimp and crab is more inelastic than the demand for lobster, scallops, oysters, clams, salmon, and tuna. Demand elasticities for tuna and salmon were found to be less inelastic than the demand for oysters, the species reported to have the least inelastic demand of the shellfish studied.

Income

Both time-series data from market statistics and cross-section data from household surveys have been used to examine the effect of income on the demand for fish. Upon examining the results obtained from the National Marine Fisheries Service's panel survey, Nash [13, p. 16] concluded that "income does not appear to be as strong a factor in explaining purchases [fish] as is sometimes ascribed to it." He noted, as did Purcell and Raunikar [16], that consumption of fish does not increase continuously over all income categories. On the species level, low income households indicated frequent purchases of red snapper, catfish, and whiting. Households in higher income groups reported larger purchases of shrimp, clams, and scallops.

Estimates of the income elasticity of demand using both time-series and cross-section data appear to confirm Nash's conclusion. Waugh and Norton [21, p. 35], using time-series data, produced an income elasticity of —0.02. The "T" value reported, however, failed to reveal statistical significance. The time-series analysis conducted by George and King [7, p. 51] yielded an elasticity of 0.004, compared with respective elasticities of 0.29, 0.59, 0.13, 0.57, 0.17, and 0.77 for beef, veal, pork, lamb and mutton, chicken, and turkey. An income elasticity of —0.06 has been produced from cross-section data [7, p. 70]. Similar elasticities of 0.27, 0.55, 0.01, 0.591, —0.034, and 0.768 were obtained respective to beef, veal, pork, lamb and mutton, chicken, and turkey [7, p. 70].

Income elasticities of demand derived for individual species, using time-series data, illustrate that the importance of income on marginal consumption varies considerably among species. Respective income elasticities of 2.07, 1.87, 1.70, and 1.17 have been indicated for lobster, crab, shrimp, and tuna. Negative elasticities have been reported for oysters, salmon, and halibut. Given these findings, it is not at all surprising that the importance of income on the marginal consumption of all seafood has been found to be of minor significance.

Substitute relation with other meat products

In the United States, fish compete with meat and poultry for a place in the consumer meal. While each is usually served as a part of the main course, they are infrequently served together. To study the competitive relationship that exists between meat, poultry, and fish,

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[2] Demand relationships for a wide variety of fish have been inventoried by Nash and Bell [14].

Waugh and Norton [21] analyzed annual indexes of per capita consumption, deflated retail prices, and deflated per capita incomes for the period 1935 through 1967. The result of the analysis was a cross price elasticity between fish and meat of 0.47. The cross effect found between fish and poultry was negative and lacking in statistical significance.

George and King, using data that spanned from the late '40s through the late '60s, estimated cross price elasticities between fish and beef, veal, pork, lamb and mutton, chicken, and turkey. These elasticities range from a low of 0.002 to a high of 0.026. The quantity of fish consumed was found to be least responsive to the change in the price of turkey. The strongest cross price effects were those between fish and pork, and fish and beef.

Substitute relation among species

In addition to considering the competitive relationship between fish and meat, it is also useful to analyze the extent of substitution among species. Salmon and tuna account for most of the canned fish consumed in the U. S. The most popular canned fish product in the 1920s and 1930s was salmon. Since the 1960s, however, tuna has been the major canned fish item. A 1 percent change in the price of salmon has been indicated to increase per capita consumption of canned tuna by 0.5 of a pound [21, p. 42]. The existence of a substitute relationship between oysters and clams has also been suggested [12, 20].

Other Demand Parameters

Other socioeconomic factors, in addition to income, have been found to influence purchases of fish for home use. Of these factors, ethnic background, household size, and age have been found to be of importance.

To resolve whether or not ethnic background influenced fish consumption patterns, Nash [13] examined the purchases of various racial and religious groups. Data collected indicated that black families consumed twice as much shrimp as white families. Blacks were also found to consume larger quantities of oysters, crabs, ocean perch, red snapper, catfish, and whiting. White families were found to have purchased larger quantities of lobster and halibut. Nash's survey results confirmed the findings of an earlier panel survey conducted in Atlanta, Georgia. Purcell and Raunikar [16] reported that the results of the Atlanta survey indicated the quantity of fish and shellfish purchases by non-white households exceeded similar purchases of white households by 82 percent. Among the religious sets delineated by Nash, Jewish households were found to consume the largest quantities of fish. Catholic households were the second largest consumers of fish with fish consumption lowest among Protestants.

Several studies have examined how household size effects fish consumption. Nash [13], in the only study that was national in scope, found that per capita consumption of fish declined as family size increased. It was also reported that low-priced purchases increased with family size. Results of the Atlanta [16] and Massachusetts [6] surveys both indicated an increase in the total quantity of fish and shellfish purchases as family size increased. However, when Purcell and Raunikar [16] viewed consumption on the per capita level, consumption and family size were found to be inversely related, a result verified by Nash's study for the nation.

Survey results have indicated higher rates of fish consumption among older consumers, people 45 and over. It has been reported by Miller and Nash [12, p. 13] that households headed by persons 45 years and older account for 72 percent of the oysters, 68 percent of the clams, 58 percent of the finfish, and 58 percent of the canned fish consumed in the U. S. Viewed in light of the fact that these households account for approximately 50 percent of all the households in the U. S., it is apparent that they consume more than their proportionate share of fish. It was also revealed that households headed by persons 35 years of age, 28 percent of all U. S. households, consumed only 20 percent of the oysters, 14 percent of the clams, 23 percent of the finfish, and 22 percent of the canned fish consumed nationally. These data indicate that age may be a very important determinant of fish consumption as the age structure of the nation changes through time.

Interregional Demand Variations

Consumption patterns evolve over long periods of time. In the case of fish, cultural and technological influences have played important roles in fixing regional patterns of consumption.

The New England region, Figure 1, leads the U. S. in per capita consumption of fish, with each person consuming 17.6 pounds over a 12 month period. The East South Central and West South Central follow with per capita consumption over the same time span of 17.2 and 16.5

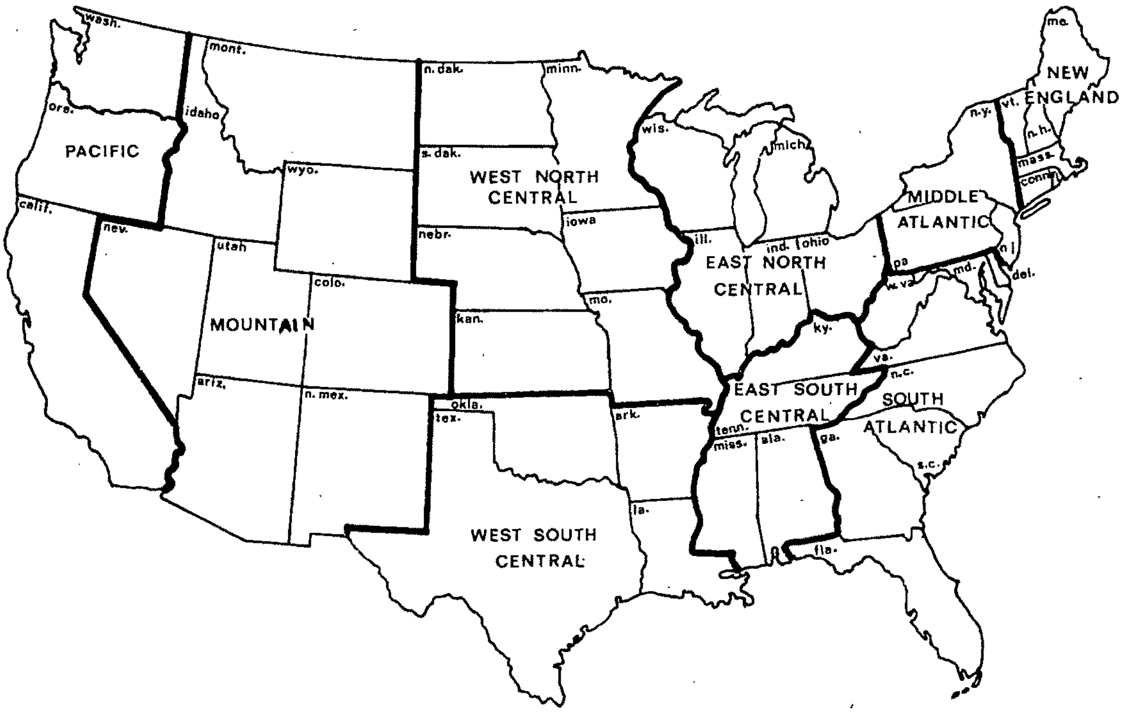

Figure 1. Regional delineation of the United States

pounds, respectively. Per capita consumption of fish is lowest in the West North Central region, 7.90 pounds. The popularity of different varieties of fish varies from region to region. In New England, for example, shellfish are very popular with the per capita consumption at-home of 4.1 pounds far exceeding the national average of 1.8 pounds. On the other hand, per capita finfish consumption in New England, 5.8 pounds, is only slightly above the national average of 4.9 pounds. The reverse is true for fish consumption patterns in the West South Central States. Finfish consumption per capita at-home in the West South Central region exceeds the national average by 3.7 pounds, while average per capita consumption of shellfish is 0.18 pounds below the average.

When per capita consumption is examined by species, the reasons for different regional consumption patterns becomes more apparent. For example, oyster consumption in the South Atlantic states, 0.47 pounds per capita, is more than double the national average [12, p. 16]. Per capita consumption in the East and West South Central regions, two regions located in close proximity to important oyster producing beds, ranks second and fourth respectively in national oyster consumption. Thus, these data reveal that areas with the highest rates of per capita consumption are also the major oyster producing areas. In aggregate these areas account for over 60 percent of the total oysters consumed at home, and further, they consume about 84 percent of their total production [12, p. 3]. Cultural and technological influences have more than likely played important roles in shaping these patterns. In the case of oysters, technological factors have been very important. Historically, oysters have been preferred in a "fresh" form. The perishability of oysters in this product form has reduced incentives to develop extensive distant markets.

Heavy shrimp consumption in the South Atlantic and South Central States is also indicative of the tendency for seafood products to be consumed in the area of harvest [12, p. 7]. Miller and Nash [12] found evidence that indicated concentrations of consumption in the area of production for clams, crabs, lobsters, and scallops. Close proximity to production areas and consumption of finfish are also closely related. Per capita purchases of salmon by users residing in the Pacific region far exceed purchases per capita in other regions [13]. Nash [13, p. 15] reported that red snapper is most important in the East and West South Central areas and in the Pacific states.

Differences have also been reported to exist in consumption patterns within regions. Krebs and Storey [10] found that residents in Quincy, Massachusetts, a coastal community, purchased fresh fish more often than residents in Binghamton, New York. Purchases of frozen fish in the New York community were found to exceed similar purchases in Quincy. Similar findings have been reported for two Virginia communities. While reporting only slight differences in consumer eating patterns for Norfolk and Roanoke, Virginia, Long and Coale [11] concluded that much of the difference documented was attributed, partially, to product availability.

Supply

Potential physical supply

The productive potential of oceanic living resources is not accurately known. Depending upon the assessment method used, the estimated total yield ranges from 55 to 2,000 million tons [8, pp. 248–249]. For the most part the smaller estimates tend to be those extrapolated from catch trends or existing knowledge of world fish resources. The liberal estimates have been derived from the theoretical flow of energy through the trophic layers of the marine food chain.

Estimates of potential yield have been made for all those creatures that support major fisheries by the Food and Agricultural Organization of the United Nations [8]. The world's large pelagic, demersal, and shoaling pelagic marine creatures are estimated to have a yield potential of approximately 100 million tons per year. Species covered by these three groupings include, for example, salmon, tuna, skipjack, bonito, flounders; cod, haddock, snappers, anchovies, herrings, sardines, and mackerel. Lobsters, shrimps, prawns, crabs, and other marine crustaceans are indicated to be capable of providing in the vicinity of 2 million tons annually. Large quantities of squid, cuttlefish, and octopus are harvested; however, no estimated potential is available. The potential of squid is considered to be large. No estimate was made for clams, oysters, and other mollusks because of the possibilities of increased harvest by cultivation. For smaller animals such as the krill of the Antarctic and the lantern fish, potential yield is estimated at several times the present world catch of all fishes. While it is not possible to harvest these economically at present, the establishment of operations on a commercial scale is considered to be in the not too distant future.

The term "potential yield," as used in the FAO study, is the sum of sustainable yields of each individual stock of fish, in the group concerned, under average environmental conditions, with the pattern of fishing on each stock adjusted to make the yield a maximum [5, p. 9]. Therefore, the estimates are maximum sustainable yields. Thus the potential yields are upper limits of what can be taken on a sustained basis when harvesting is technologically and economically feasible.

With reference to the status of world fisheries, Gulland [8, p. 252] has made two general remarks: first, he has stated that significant catch increases of traditional stocks cannot be maintained; second, large increases in the production of food from the sea can be achieved by turning to under-utilized species.

Coastal waters adjacent to the U. S. support an abundance of marine life. These very productive waters have been fished by both domestic and foreign vessels. While some species located in U. S. adjacent waters can support considerable catch increases on a world-wide basis, they are fished very heavily near U. S. coasts. Bell *et al.* [2, p. 36] have indicated that catch levels have reached critical limits for crabs, tuna, salmon, halibut, and Atlantic groundfish. Tanner crab, northern shrimp, calico scallops, offshore lobsters, and offshore clams were indicated to be capable of supporting catch increases. Therefore, it appears that under-utilized species will also play an important role in the future expansion of U. S. fisheries.

World competition for fishery resources

Of the many developments that have characterized world fisheries, it is the recent intensification of distant water efforts by numerous nations that looms as most important. The disposition of the catch taken in the Central Eastern Pacific is indicative of the expansion in distant-water effort that has taken place. Christy [4, p. 13] indicated that the catch of African states bordering the Central Eastern Pacific dropped from 85 to 40 percent between 1958 and 1969. The balance of the 1969 harvest was accounted for by 15 foreign states, including Russia, Spain, and Japan.

Since World War II fishing fleets from numerous nations have extended their fishing activities into fisheries off the coast of the U. S. After the War both Japan and the Soviet Union began competing with the U. S. for marine resources off the coast of Alaska. More recently Soviet vessels have also been recorded pursuing

Pacific hake off the coasts of Washington, Oregon, and Northern California.

Expansion of fishing activities has not been limited to developed countries. Aided by the development of long range self-contained freezing trailers, integrated fishing fleets, and the willingness of fisherman to work for long hours for low wages, some underdeveloped countries have been able to expand their fishing activities. For example, Korean longline tuna vessels fish all over the world. Ghana has vessels operating off Morocco.

The extent of interest in and perhaps an indication of future increases in the degree of competition between nations for marine creatures is given by the following statement made by Christy:

> The growing value of fisheries combined with the increased perception of the values, combined with the growing ocean interests of more independent states, all lead to increased demands for sharing in the sea's wealth. A decade ago, many states would have been satisfied by simply having the option to fish that was guaranteed to them under the principle of the freedom of the seas. But this option is now of little value. The opportunities that might be found in increases in world catch are now known to be quite limited. And the value of the option is further reduced by exclusionary tendencies in multilateral fishery arrangements. The declining value of the option is another stimulus to the demands for participating directly in distribution of the fisheries wealth. [4, p. 21]

Mariculture

Aquaculture, the growing of aquatic organisms under controlled conditions, has been practiced for hundreds of years. Recent intensification of interest in it can be attributed partially to the realization that the harvest limits of wild aquatic organisms is being reached.

Lack of data has made assessment of world production through aquaculture difficult. Information collected by the FAO indicates that world production during 1970 was about 4 million tons. More recent updated data from 42 countries reveals total world production to be over 5.0 million tons, 3.7 million tons of finfish, 1.0 million tons of mollusks, and 0.4 million tons of seaweed [15, p. 2205]. This total reflects tonnage derived from fresh, brackish, and saline waters. Fish culturing activities in the United States account for approximately 8 percent of the 5 million tons, with oyster and catfish production the most important forms.

The development of the culture of marine fish species has lagged behind that associated with fresh and brackish varieties. It has been stated that true mariculture is barely in its infancy [1, p. 24]. The major mariculture industries are for shellfish, principally oysters and mussels. Yellowtail culturing activities have expanded in recent years in Japan. Between 1958 and 1968 the Japanese expanded the production of yellowtail from 300 to 30,000 metric tons [1, p. 563]. Other estuarine animals raised included lobsters, clams, abalone, scallops, pompano, and plaice. For most of these species commercial production is insignificant, with the culture of most being still in the laboratory or early pilot stages.

Economic supply

Assuming that the world is divided up into regions, the world maximum sustainable yield (MSY) is the sum of the MSY's for each individual region. To attain world MSY, each region would have to be maintained at its maximum sustainable yield. This is biologically possible but unfeasible under competitive conditions.

The world supply of fish at any given price is the sum of the amounts that would be supplied by each region at that price. The locus of all such points constitutes the world supply curve for fish, Figure 2. This curve has been referred to as the curve of world sustainable supply [2, p. 99].[3] On the supply side, the corollary to maximum sustainable yield is maximum sustainable supply. Bell *et al.* [2] have estimated world MSS's for tuna (3,659 million lbs.), salmon (1,069 million lbs.), groundfish (15,400 million lbs.), halibut (129 million lbs.), shrimp (3,278 million lbs.), crabs (1,253 million lbs.), lobsters (424 millon lbs.), clams (1,762 million lbs.), scallops (844 million lbs.), other food fish (153,881 million lbs.), and species for reduction (66,400 million lbs.). With the exception of clams and scallops, it is estimated that all of the species will reach the point of maximum sustainable supply in the 1985-2000 period. Salmon, halibut, and groundfish were indicated to be currently exploited at their MSS's. Estimates of MSS are not available for U. S. ocean fisheries. However, respective maximum sustainable yield for the species mentioned of about 792, 407, 5, 157, 59, 317, 343, 66, 381, and 1,034 thousand

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[3] Behind the world sustainable supply curve is the assumption of no controls. It assumes only the normal competitive responses of the fishing industry to prices and cost.

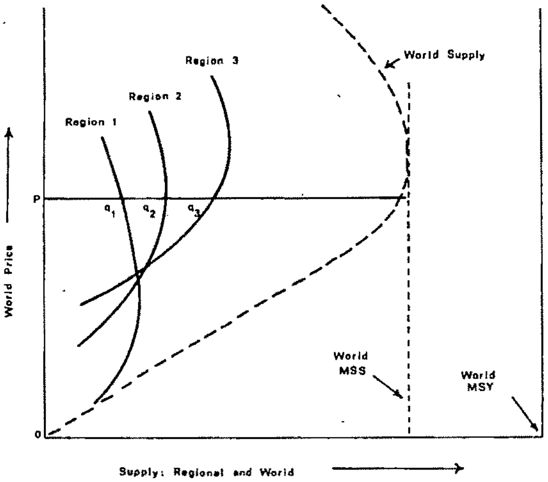

Figure 2. **World supply and regional supply**

metric tons, can be used as upper limits on U. S. MSS's.[4]

Marketing System

There are generally several stages which comprise the distribution channel for seafood. It is the primary wholesalers, processors, secondary wholesalers, and retailers that are the critical links in the marketing system. The activities encompassed within the distribution process from the time the fish are caught until they are sold at the retail counter depends upon the species and product form. For example, in the case of frozen products, cold storage would play an important role. Inventories may be held by processor plants, cold storage plants, wholesalers, and retail chain cold storage plants. While deviations exist, it is felt that the distribution stages mentioned above provide an adequate description of the marketing channel for seafood. It is necessary to note the role of brokers. In many markets they serve as intermediaries between processor and wholesaler or even retailer. However, it is becoming increasingly common for large processors to bypass intermediaries and sell directly to large retail food chains.

The bypassing of stages between the processor and the retailer might be interpreted as movement of the seafood industry toward vertical integration. There has been some acquisition of fish processors by food conglomerates; however, the movement has not affected all segments of the seafood industry. A study of the Northwest fresh and frozen salmon industry indicated the absence of vertical integration [17].

Future Position of Seafood in the U. S. Food Basket

In 1973 retail food prices averaged 14.5 percent above 1972 prices. The extent of the 1974 increase will depend upon how much food output is stepped up, the strength of the demand for food commodities, and the conditions in the U. S. economy. Under expected conditions retail food prices for all of 1974 are predicted to average 12 percent above their 1973 level [19, p. 3].

The recent increase in food prices has resulted in decreased per capita consumption of meat, poultry, and fish. Fish have experienced the smallest decline. While absolute fish consumption has declined slightly, relative consumption has increased. This leads to the following question, "will relative fish consumption continue to increase?" Indications are that upward pressures will continue to be exerted on food prices by higher marketing and distribution costs. These factors will affect all food prices. Predicted crop supplies, smaller than those expected, could force meat and poultry prices to remain high. U. S. fisheries as a whole appear to be capable of withstanding increased market pressure. Barring the occurrence of any unforeseen phenomenon, fish supplies appear capable of supporting larger consumption levels. While this holds for fisheries as a whole, it must be noted that some fisheries are currently being exploited at their potential. Other fisheries will have to be relied upon. Therefore, in the short run it appears that seafood is capable of supporting a stronger position in the U. S. food basket.

While fisheries appear capable of supporting a larger role than currently occupied in the U. S. food basket in the short run, the picture is less favorable for the long run. Bell *et al.* [2] indicate that by the year 2000 the reaching of world potential for species fished by U. S. fishermen will put increasing pressure on U. S. stocks which, in many cases, are almost fully utilized. Therefore it would appear that the development of under-utilized species will determine the future extent of the amount of seafood in the food basket.

Summary

Consumption of seafood in the U.-S. is low relative to that of some foreign countries. Consumer demand for seafood is inelastic with respect to price and income. Various socioeconomic factors such as household size, age, and region affect consumption. While fish populations upon which major U. S. fisheries are based appear capable of withstanding short-run pressures, maximum sustainable supplies will be approached before the year 2000. Mariculture appears to possess the potential of adding to the supply of fish; however, the industry is in its infancy. The recent increase in relative consumption of seafood is capable of being supported and expanded by present stock levels. In the long run maximum sustainable supplies will be reached; thus the position of seafood in the food basket could be weakened especially if under-utilized fisheries are not developed.

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The Economist and the Seafood Producer

FREDERICK J. SMITH

SEAFOOD PRODUCTION ECONOMICS is a relatively new research and extension area for agricultural and resource economists. Currently, there are 13 Sea Grant supported seafood production economics research projects at the University of Maine, University of Rhode Island, University of Maryland, Virginia Polytechnic Institute, North Carolina State University, Clemson University, University of Florida, Texas A&M University, University of California, and Oregon State University. The National Marine Fisheries Service also supports seafood production economics research projects at their own Economic Research Division, their regional offices, and at several universities.

Seafood production economics extension work is currently being supported by Sea Grant funds in Rhode Island, Delaware, Virginia, North Carolina, South Carolina, Florida, Alabama, Mississippi, Texas, Oregon, and Washington. Several states are also reallocating some Land Grant funds for extension work in seafood production economics.

Costs and returns in commercial fishing and seafood processing were dealt with in the 1950 through 1969 fisheries management policy debates. However, during this period seafood production economics was only an appurtenance to policy concerns. Leaders in this early work were Crutchfield, Zellner, Scott, Pontecorvo, Smith, and Comitini. It is interesting to note that none of these people have an agricultural economics background, whereas nearly all the seafood production economics work currently under way (for its own sake and not subsidiary to policy) is being conducted in agricultural or resource economics departments and/or by agricultural economics trained people.

Therefore, seafood production economics research has a new focus and has very nearly become the exclusive domain of agricultural and resource economists. This is not new information to those who belong to the small marine economics "fraternity." However, for those outside the fraternity, it may be beneficial to become acquainted with U. S. seafood producers and become familiar with the current seafood production economics research and extension work in the United States. The purpose of this paper is to (1) describe and characterize U. S. seafood producers; (2) briefly review current seafood production economics research; and (3) identify some needs and opportunities for the future.

Characteristics of United States Fishermen

There are over 25 major fisheries in the United States, differentiated by species, production technology, and geography. Fishermen may participate in one, two, three, or four different fisheries in one year, using a wide variety of production technology in locations 2,000 miles apart. The National Marine Fisheries Service [7] reported 140,538 U. S. fishermen in 1970, using 87,161 boats. Some of these fishermen depend entirely upon seafood production for survival, while many obtain the majority of their gross earnings from other sources.

A complete description of such a heterogenous group would be time- and space-consuming beyond the scope of this paper. However, such a description is simplified if U. S. commercial fishermen can be grouped or categorized according to fishery, investment, or objective functions. Research at Oregon State University suggests that categorization by objective function helps explain profitability and behavior. It is also possible to categorize by objective function into as few as three groups.

Fishermen's objective functions are comprised of monetary and non-monetary rewards. Monetary rewards are measured in terms of profit, gross earnings, fish landed, and investment. Non-monetary rewards predominant in the fishing industry include: the challenge of fishing, freedom and independence, the joy and pleasure of the sea, and fellowship.

The first of three relatively homogenous groups includes fishermen who have objective functions in which non-monetary rewards are of primary importance and monetary rewards are of secondary importance. These fishermen produce seafood with a relatively high market value. They use relatively unsophisticated production technology and usually own and operate their own boats. There are few, if any, employees, and participation in the fishery is frequently seasonal and will vary from year to year.

Most notable in this group are the inshore

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lobster fishermen of New England, who seldom have more than $50,000 invested in their business, and the Pacific salmon and tuna fishermen who may have up to $80,000 invested. Salmon gillnetting in the Pacific Northwest and Alaska is another highly seasonal low investment fishery. There are still many cannery-owned gillnet boats in Alaska fished by part-time hired skippers. The Atlantic Coast and the Gulf of Mexico support a sizable hook and line, and net fishery. These fishermen also sustain themselves as much from the non-monetary rewards as from the mullet, mackerel, rockfish, and other finfish harvested. Many watermen of Chesapeake Bay also belong to this group.

Fishermen in this group represent the majority of the approximately 140,000 U. S. fishermen. However, they are not well organized politically, nor do they have a significant collective economic impact.

Fewer in number, but more important in terms of political power, are fishermen who have objective functions in which monetary rewards are primary, and non-monetary rewards are secondary. The fishermen in this second group produce high-volume, low-value seafood as well as low-volume, high-value seafood. Production technology tends to be more complex, although less skill may be required than with simple harvest technology. Investments may range from $50,000 to $500,000, and owner/operators predominate. There may be from one to six employees with varying skill requirements. If the boat cannot be utilized in one fishery throughout the year, fishermen in this group tend to be flexible and participate in two, three, or four different fisheries.

Although many of the boats are company (seafood processor) owned, the Gulf of Mexico shrimp fishermen exemplify this group. The offshore lobster fishermen of New England, with $250,000 invested and the ability to fish flounder and cod, also exemplify this group. Others include the North Atlantic scallop fisherman; the North Atlantic drag boat skipper; the West Coast shrimp, sole, rockfish, and cod fisherman; the North Pacific halibut long-line fisherman; the Washington and Alaska salmon purse seine fisherman; and the Pacific Northwest combination (salmon, albacore tuna, and dungeness crab) boat skipper.

Fishermen with objective functions in which monetary rewards clearly dominate are the least in number, but the greatest in economic importance. The seafood product usually has a high market value and is produced in large volume. Production technology is very complex and frequently requires the employment of technical specialists. Investments of $1 million are common, with some fishing companies operating several $1 million boats. Skippers may work for the fishing company, and as many as 15 employees may be on board.

While not of the same scale as the factory ships of the Soviet Union, Poland, and East Germany, the U. S. tropical tuna seiner is very impressive. It is also very efficient and characteristic of this group. The king crab fishermen of Western Alaska also exemplify this group, as do some of the Western Alaska shrimp fishermen, Gulf of Mexico shrimp fishermen, and North Atlantic drag boat skippers.

Characteristics of Seafood Dealers and Processors

The seafood dealer usually markets fish in the same form as they are landed. Dealers handle a majority of the South Atlantic finfishes, northern lobster, troll-caught salmon, some blue and dungeness crab, and clams. The dealer, as opposed to the processor, may hold fish on ice or in cold storage for only a day or two, then ship to the wholesale or retail market.

In addition to shipping, the seafood processor also cleans, shells, cooks, fillets, cans, freezes, boxes, and frequently inventories the seafood. As little as 10 percent, or as much as 95 percent, of the raw product may be marketable as food. This increases the price differential between the fisherman and consumer and results in large volumes of troublesome waste.

Since there are only approximately 3,735 seafood dealers and processors [7] compared to 140,538 fishermen, description without categorization becomes feasible. However, processors can be differentiated in terms of scale and vertical integration. Sales volumes range from $50,000 to $100 million. Only 36 percent of the 220 West Coast processors and dealers had sales in excess of $500,000.

Except for several specialized tuna canneries, those at the top are highly integrated manufacturing and marketing organizations dealing in nearly every seafood product. They have subsidiary plants in many major U. S. ports and operate buying stations in others.

Most other seafood processors and dealers tend to specialize in two, three, or four seafoods and obtain supplies on a regional rather than on a national or international basis. Among this majority in number, but minority in volume, there has been a long-standing management concept. Most attempt to maximize profit through price spreads, inventory manipulation, and market speculation, rather than through maximum processing and marketing efficiency. Conditions that make this possible, and the consequences of this concept, are subjects for another paper.

New management in many of the smaller seafood processing firms has been drawn from younger family members or management-inexperienced plant employees. This, plus the lack of emphasis on production efficiency, has resulted in antiquated seafood processing technology and high operating costs. Many processing operations are housed in old buildings perched on rotting pilings. They are great photographic subjects for the tourist and a challenge to sanitation inspectors and plant engineers.

There are many notable exceptions to the above characterization of seafood processors and dealers, some of which are organized as cooperatives. Most of the approximately 80 fishery cooperatives in the United States simply act as agents for their members. However, the cooperatives at Provincetown, Massachusetts, Point Judith, Rhode Island, and the Halibut Producers Cooperative in Seattle are examples of efficient and successful seafood processors.

The Economic Environment

Risk, in the form of biological and regulatory variability, externalities inherent in common property resource-based industries, and an oligopsonistic market, characterize the economic environment within which the seafood producer operates.

With the exception of aquaculturists, all fishermen harvest from a common pool of living marine resources. Many eloquent words have been produced on the common property problem in the fishery. A quote from Gates and Norton will summarize sufficiently for our purposes:

> . . . the high rate of foreign fishing, the old age of vessels and crewmen, and the low earnings to labor and capital in certain fisheries are . . . characteristic of a common property resource in which there is no ownership of the resource [and] entry into the fishery takes place as long as there is economic rent or profit to be earned. This means that in any fishery, unless there are restrictions on entry, fishing effort tends to increase to a level where average profits—or economic rent attributable to the resource—is dissipated. Therefore, while some vessels in each fishery earn a profit, the tendency is toward zero profits, with the result being old crewmen and vessels, and low earnings to labor and capital. [9]

Fishery regulations are instituted on a regional or state-by-state basis, and by differing agencies. The agency decision-making process is based upon political expediency as well as biological needs. This adds a somewhat unique risk dimension to the fishing and seafood processing business.

Natural biological variability adds another risk dimension to the fishing business. Our ability to predict major fluctuations in fishery stocks is still inadequate, in spite of sizable money and time expenditures.

The Economist's Contribution to Knowledge

As indicated earlier, the National Sea Grant Office currently supports 13 research projects in seafood production economics. Approximately $225,000 is allocated to these 13 projects. This represents only 17 percent of Sea Grant's total allocation to marine socioeconomics and legal research. The National Marine Fisheries Service is the other major funding source for research in seafood production economics. However, most of its funding is internal and integrated with other functions of this agency.

Much of the currently available literature dealing with the economics of seafood production has resulted from a variety of non-Sea Grant funded sources including Agricultural Experiment Stations, state fishery agencies, banks, the National Marine Fisheries Service, Bonneville Power Administration, and the National Science Foundation. Because seafood production economics research has been a subordinate to policy research, supported by so many different sources, published by different organizations, and conducted at many non-academic as well as academic institutions, identifying this work and giving proper recognition is difficult, at best. The seafood production economics research that has been identified can be conveniently classified as:

(1) development of economic data and economic description of seafood producers, or
(2) economic analysis of the seafood producing firm.

To date, the economist's greatest contribution has been in developing basic economic data and describing the seafood producer. This type of work has been extremely important, valuable, and is likely to continue. However, economists have not been latent in analyzing the economics of seafood production, in spite of a severe lack of data.

Economic Data and Description

The most comprehensive (although not the first) research in this area was conducted by the Economic Research Division of the National Marine Fisheries Service. This research was based upon data obtained from fishermen's records and National Marine Fisheries Market News sources. There are currently 10 reports available, each of which includes "Industry performance indicators," "Demand indicators," "Demand projections," "Domestic production," "Domestic employment, vessels, and effort," "Biological stock assessment," "International trade," "Foreign production," "Foreign consumption," "U. S. trade barriers," and "Government programs" [22]. Perhaps the greatest contribution of the National Marine Fisheries Service work is in its comprehensive nature. Data for as many as 24 years for each of 10 fisheries are available under some of the above headings. In-depth knowledge of any one of the 10 fisheries is obtainable from these reports.

The "Industry performance indicators" section of these reports includes costs and returns data on boats in the particular fishery. The greatest difficulty with these costs and returns data is the inconsistency in sources. Not only are the sources different for different reports, but there are no estimates of how well the data represents the population. In many cases such estimates would be difficult, at best, because there is little knowledge of the population. As we shall see, this is a major problem for all current costs and returns studies of seafood producers.

The first seafood producer costs and returns study published by an agricultural economics department came from Georgia in 1968 [5]. In addition to the usual descriptive material and catch statistics, this study was one of the first to report cost breakdowns by boat size and type of ownership. The major contribution, however, was an attempt to estimate functional relationships for the fishing firm.

By 1970 the first costs and returns data resulting from Sea Grant funding began appearing. The work at Oregon State University has resulted in available data for 50 different boats and fisheries [19, 20]. The University of Florida has published data on mullet fishermen [2]; the University of Hawaii has produced a publication on the costs and returns of local tuna boats [3]; and Texas A&M University has utilized National Marine Fisheries Service data to produce a shrimp boat costs and returns study [15]. Costs and returns work underway or completed but not published includes a study of small shallow-water boats in Guam by the University of Guam and a more current (1973) shrimp boat costs and returns study by Texas A&M University.

The National Marine Fisheries Service is conducting a costs and returns study of the spiny lobster fishery of Florida, using data from the 1972-73 season. A new study is underway at the National Marine Fisheries Service Gloucester Laboratory on the earnings of multi-specie New England fishing boats.

Perhaps the most ambitious descriptive study currently underway is at the University of Florida. Prochaska and Cato have obtained Sea Grant funding to determine the social, cultural, and economic characteristics of Florida fishermen, and to analyze costs and returns. Their proposal is projected to continue until 1978 and is written quite broadly. As their data base develops, the descriptive character of their work is likely to become less important than the economic analysis.

Two early studies that involved some analytical work as well as costs and returns data appeared in *Fishery Industrial Research* [10, 16]. In some respects these were predecessors to the series of National Marine Fisheries Service reports referenced earlier. They include costs and returns data taken from cooperating fishermen in the San Pedro-based wetfish boat fleet (purse seiners for mackerel, sardines, bonita, etc.), and the San Diego-based tropical tuna fleet, and an analysis of vessel sizes and fleet expansion.

The tropical tuna study has some historical significance. Green and Broadhead [10] were able to demonstrate potential economies of size for tuna purse seine boats. They projected profit gains for increased boat sizes up to 400 tons. At about the time of this study, a minor revolution took place in the size of tuna boats being constructed; sizes were doubled and tripled. Out of 132 boats now operating in the U. S. tropical tuna fleet, only 51 have capacities less than 400 tons, and seven have capacities in excess of 1,000 tons. If the study can be faulted, it must be because Green and Broadhead were not visionary enough to see economies of size beyond 400-ton capacities.

Crutchfield [6] completed a descriptive study for the Bonneville Power Administration in 1967. This was the first comprehensive look at fisheries in the Pacific Northwest. It includes a discussion (no data) of demand for Pacific Northwest fish, landings data, some supply projections, and some description of the fisherman population.

Costs and returns research on seafood processors and dealers is much less impressive in both quantity and quality. The Seattle and Juneau office of the National Marine Fisheries Service has a major study underway to determine the economic feasibility of expanding the sole and rockfish industry of Alaska. Costs and returns analysis of three sizes of seafood processing plants are included in this study.

Additional work has been conducted by the Juneau NMFS office in estimating the costs and returns in Alaska shrimp processing. Oregon State University has developed detailed costs and returns estimates on "typical" salmon, sole, and shrimp processing operations. This data has been utilized extensively in seafood marketing extension work.

A comprehensive study has been completed for the U. S. Environmental Protection Agency where costs and returns of every major size and type of seafood processing plant in the United States have been estimated. Unfortunately, the results of this study are not available in published form.

Agricultural economists at Virginia Polytechnic Institute have developed case study plants which represent costs and returns for Virginia seafood dealers. This data has also been used in seafood marketing extension work.

Although outside the scope of this paper, seafood production economics research in Canada deserves recognition. This work has not been insignificant. In fact, much of the work by Campbell, in British Columbia, and Proskie, in the Maritime Provinces, predates any major U. S. research. There has also been a substantial number of costs and returns studies undertaken by private firms in the U. S. Ocean Science Capital Inc., Living Marine Resources Inc., and Development Planning and Research Associates, Inc., are a few of the major U. S. consulting firms meeting the needs of private investors in the seafood industry.

A not-unjustified philosophy for seafood producer costs and returns research seems to be: "Something is better than nothing." Most of this work has an uncertain statistical base but, in nearly every case, this has been recognized and sources of data have been made explicit. Even if it were possible to identify a population and obtain a representative sample, obtaining unbiased and valid data from seafood producers is extremely difficult.

Each fishery and each fisherman has unique accounting procedures, accounting terminology, and pay systems. Accounting procedures range from a paper sack full of "fish tickets" to complete double-entry accounting systems. Not only is it difficult for the economist to understand and interpret the data acquired from seafood producers, it is nearly impossible to make the data compatible among fisheries and even among individual seafood producers. Several of the earlier costs and returns studies avoided the compatibility problem by simply reporting their work in the same terminology and using the same accounting procedures common to that fishery. This leaves the interpretation of "gross stock," "boat share," "condemned gear," and so forth to the user.

More recently, such standard terminology and procedures as "variable costs," "fixed costs," and "opportunity costs" have been used. This has made it possible for the Florida mullet fisherman to understand costs and returns data on salmon fishermen, and for California tuna fishermen to understand New England lobster fishermen's costs and returns. It has also improved communication among marine economists.

Available costs and returns and descriptive data is strictly "point in time" information. With the varying economic environment predominant in the industry, data from the same firms in successive years would be useful in further economic analysis.

Costs and returns research has provided data where data was non-existent. The increasing availability of fisheries costs and returns data has spawned some new analytical work and has provided a better index of the economic welfare of the industry. Finally, the new costs and returns data has become an important input to marine economics extension programs.

Economic Analysis of the Seafood Producing Firm

The pioneering work in economic analysis of seafood producers was concentrated in New England. Frederick Bell's work for the Federal Reserve Bank of Boston [4] was concerned with the economic feasibility of new technology (stern trawling) and the economic impact of government aid on this technological change. Among the most notable achievements were attempts to construct empirical production functions for a fishing firm (various forms of the Cobb-Douglas were used), and a theoretical production surface for analyzing a discrete change in technology.

Bell's empirical base was not sufficient for complete success. However, the study's major contribution is not in the conclusions of empirical work, but in the attempted application of agricultural economics methodology to the seafood firm.

Holmsen, in his Sea Grant-supported work titled "Remuneration, Ownership, and Investment Decisions in the Fishing Industry" [14], examines the effect of different crew payment systems on profitability and productivity in a fishery. He explains several crew payment systems and illustrates graphically the effects of each system on resource allocation and organization within the fishing firm.

There is an increasing amount of research which attempts to explain profitability or lack of profitability in seafood production. Holmsen [13] grouped 24 New England trawlers into low return on capital and high return on capital categories. He then compared such observable characteristics as boat size, engine size, market value, gross returns, crewshare, and costs among the groups.

Carley [5] estimated functional relationships among costs, boat size, and landings for Georgia shrimp fishermen. The analysis was based upon 50 of 258 shrimp boats operating in Georgia at the time.

A major study to explain profitability in a fishing business is underway at Oregon State University. This study is based on a random sample of 200 fishermen from Oregon fishermen population and 750 fishermen from the Alaska fishermen population. Its objective is to estimate various profit functions. An analysis of variance will be used to identify the more significant profit-determining variables.

One major problem has appeared in this study. Validity of data is extremely difficult to measure. Little is known about the population, and data obtained from interviews are of widely varying quality. It is also hypothesized that natural biological variability and externalities would explain a significant variation in profit. Accounting for these in any profit function will cause considerable difficulty.

A common weakness of all seafood production economic analysis has been the inadequate data base. It is well recognized that the fisherman's skill is an important input in any cost, production, or profit function. Further, the significance of this and other inputs becomes disproportionately greater or lesser as the economic environment changes from year to year. Two studies (at Oregon State University and Texas A&M University) have gone beyond cross-sectional data and have attempted to obtain and use time-series data. One study (at Oregon State University) has obtained and is using fishermen skill data in economic analysis.

There is a considerable amount of new research in the economic feasibility of aquaculture. Three projects are currently funded by Sea Grant: "Economics of Aquaculture" at the University of California, "Economics of Salmonid Aquaculture in New England" at the University of Rhode Island, and "Economics of Oyster Production Under Controlled Environmental Conditions" at Oregon State University.

The University of Rhode Island project has already resulted in a report titled "Aquaculture in New England" [8]. In this study Gates and others have analyzed the biological, technical, economic, and legal criteria for further examination of the American oyster, hard clam, bay scallop, silver salmon, or American lobster as an aquacultural specie. It is a good example of competent interdisciplinary work being encouraged by Sea Grant.

The Northwest Fisheries Center of the National Marine Fisheries Service has completed an economic study of salmon aquaculture on Puget Sound. Although not published, this study offers some excellent data for the potential aquacultural entrepreneur and is another example of interdisciplinary work.

Research by Thompson and others at several Texas Universities deserves special mention. Their work is reported in three consecutive publications by Texas A&M University [18, 21, 23], and represents the use of linear programming models to develop optimal shrimp fishing investment strategies. The authors summarize their three years of work:

> That first bulletin contained a deterministic optimal control model of a shrimp fishing firm, in addition to much background information on the industry and justification for the model specification. The second publication extended the first model by incorporating unknown, but

> random, future shrimp prices and catches, and a constraint that required solvency to be maintained with a high probability, based on the probability distributions of the random prices and catches.
>
> In the third report, the original deterministic model was extended to require the purchase of integer numbers of vessels. Fractions could be purchased in the original application, but industry representatives suggested that a more realistic specification would require the purchase of integer numbers of vessels.
>
> This paper considers essentially the same model as described in the third report . . . but extends the numerical examples to include alternative sizes of boats. In addition, some relatively minor mistakes in the computer routine used to generate the numerical example . . . have been corrected, and the example is presented here in corrected form. [18, 21, 23]

The objective of the research was to develop a decision-making tool for shrimp producers. All parameters except shrimp prices and catches can be specified by the firm. Prices and catches are "learned" in each period of the dynamic model. This is a desirable feature; however, many of the other parameters are at least as difficult to specify and, in actual practice, are "learned" in each period. The model probably outruns the firms' capacity to predict costs, boat purchase prices, interest rates, and borrowing capacity—all important parameters. A sensitivity analysis of these parameters would be useful.

Sharing the Knowledge

Seafood production economics researchers have not been delinquent in sharing research results with others. In fact this may be the only area of economics where the number of publications exceeds the number of research projects. However, publications are not the only means of sharing the knowledge. As indicated earlier, several states have active extension programs in seafood production economics. Several of these extension programs have developed in conjunction with the institution's research in seafood production economics, while other extension programs have evolved and continued with no research back-up.

The relationship between seafood production economics research and extension is close. With little or no data base, and no prior economic analysis of the seafood producer, extension economists have made excellent use of their disciplines in assisting seafood producers and have been instrumental in guiding recent research. As the body of seafood production economics research and the sophistication of the audience grows, extension economists will rely more heavily upon accumulated research for effective extension programs. Until then, we will continue to see extension specialists educating seafood producers in the delights of decision making, financial management, business organization, and so forth.

Where Do We Go From Here?

Our situation in seafood production economics is analogous to a prematurely launched fishing boat with too little ballast in its tanks. If the sea becomes a little rough, the boat is likely to be swamped for lack of ballast. If the launching of seafood production economics is prematurely "discovered" by the industry, we are likely to be swamped by short-term research and extension demands. Indeed, the needs of the industry and the possibilities for economic research and extension are so great one has to be a great adventurer to "go to sea with so little ballast."

If one had complete authority over funds and effort allocation to seafood production economics research, it would be logical to apply the equimarginal principle. Assuming for the moment that this is possible, let us list the alternatives:

(1) continue descriptive work—i.e., costs and returns studies and economic characteristics of seafood producers.
(2) continue estimates of functional relationships—i.e., production functions, cost functions, profit functions.
(3) behavior predictive research—i.e., measure the firm's response to, and the impact of, varying exogenous factors.
(4) development of management tools—i.e., coping with risk and uncertainty, tools of financial analysis, forms of business organization.

Using net short-term benefits to the seafood producer as an index of marginal returns, funds and effort for the immediate future should be allocated first to Item 4, then Item 2, and finally, Items 1 or 3. If we use a longer planning horizon with the expectations of increased funding and effort, continued descriptive work and better estimates of the functional relationships within the seafood production firm should receive more attention. Finally, if our criterion is enlightened policy, behavior predictive research deserves most of the funds and effort.

In reality the allocation of funds and effort in seafood production economics research (and extension) is a function of the individual researcher's interests and motivation. The direction of future work will be determined by what the few marine economists actually do.

However, there are some problems that are easier solved if recognized by more than one seafood production economist. These include the problem of sampling, the source and extent of risk and uncertainty, and the persistence of policy concerns in microeconomic research.

We have long suspected the difficulties in sampling such an ill-defined, heterogenous, and mobile population as seafood producers. Recent experiences at Oregon State University have confirmed these suspicions. However, recent experiences have also taught us much regarding stratification, interview costs, and timing in random sampling. As common terminology evolves among the industry, and the sincere efforts of researchers are understood, sampling problems should be reduced, if not resolved. Much work still needs to be done in identifying the population. This can be expedited by close cooperation with the responsible state fishery agency.

There is some uniqueness to risk and uncertainty in the seafood production industry. This economic risk and uncertainty has given rise to peculiar management devices and decision criteria within the industry. These characteristics have been recognized by anthropologists and sociologists who have recently "discovered" the fisherman and are studying him intensively [1, 11, 12, 17]. There is an equal challenge for economists to develop management devices and decision procedures for financial success in the uncertain economic environment of fisheries.

Seafood producers are beginning to "organize" in an attempt to cope with risk and uncertainty. The reallocation of the individual seafood producer's labor, management, and capital to collective action will have both a positive and an adverse effect upon his business. How might this be measured? How can we predict the results?

Most of the recent and current research in estimating seafood production functions and profit functions borrows heavily from traditional agricultural models. With the greater number and importance of non-controllable variables in seafood production, can we be satisfied with these models? In fact, is it even valid to specify production or profit as a function of labor and capital? The coefficient for labor and capital may be insignificant, relative to the coefficients for biological stock, fishing time available, number of other participants in the fishery, and other non-controllable variables. Does the concept of a production or profit function make any sense under these circumstances?

Finally, seafood production economics research can be justified of its own accord and does not have to be supportive of fisheries policy research. It is possible to take policy as given and conduct research of great benefit to the individual seafood producer.

Coordination and Communication

The experience of preparing this paper has been beneficial in several respects. First, there was a naïve notion that most of the work in seafood production economics was known to the author. Such was not the case, as additional work continues to be discovered beyond the due date of the paper. The lesson in this is that the work is widely scattered—geographically, academically, and professionally. Without many personal contacts, much seafood production economics research and extension would be undiscovered by the profession. Perhaps some form of organized communication or coordination among those participating would reduce the cost to each researcher and to the funding sources.

Second, in spite of the considerable seafood economics production research and extension work underway, it is of much less magnitude and scope than first envisioned. It is well publicized and well published; however, it has not yet reached the stature of marketing economics, water resources economics, and other corollaries to agricultural economics.

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Session 8

MARINE ECONOMICS: PRODUCTION AND MARKETING OF SEAFOOD PRODUCTS

Discussants: James C. Cato, University of Florida; Charles W. Coale, Virginia Polytechnic Institute and State University; Donald F. Mulvihill, Kent State University

Session 9

AGRICULTURAL FINANCE AND ECONOMIC POLICY

CHAIRMAN: EDWIN C. PRICE, JR., BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM, WASHINGTON, D. C.

Impact of Monetary Actions on Farm Income and Finance

DARRYL R. FRANCIS

FOR MORE THAN A DECADE the United States has experienced accelerating inflation. Since late 1971 average prices have risen at a rate of 5 percent per year, measured by the Gross National Product (GNP) deflator, and the wholesale price index of all commodities has risen an average of 14 percent per year.

The general inflation has prompted a number of studies concerning its impact on agriculture. Most of the studies were limited to comments on the effects of inflation, rather than monetary actions on agriculture. Nevertheless, if one believes, as I do, that excessive monetary growth is the major cause of inflation, the influence of monetary actions is implied.

The impact on agriculture attributed to inflation varied widely in these studies, ranging from real wealth gains to nominal and real wealth losses. One writer went so far as to conclude that inflation depressed those incomes realized from the production of feed grains, wheat, and cotton compared with income from meat animals, poultry, fruits, and vegetables [4, p. 913]. Another found a close and consistent relationship between changes in the stock of money and changes in agricultural income and investment, and concluded that agriculture is far more closely related to, and integrated with, the total economy than is currently recognized [9].

The inconsistency of the findings is a reminder of the questioning disposition of the famous French philosopher, Michael de Montaigne (1533–92), who, after years of concentration prior to writing his essays, decided that absolute facts were nonexistent. Rather than accept this pessimistic view, I suggest that most of the inconsistency reflects the difficulty in determining cause and effect relationships in agriculture and differences in the time horizon of the researchers.

In agriculture, cause and effect relationships are clouded by a number of nonmonetary destabilizing elements which can have a sizable effect between the planning of production and the realization of output. Output and demand fluctuations occur as a result of unanticipated factors such as unusual weather and other natural disturbances, livestock cycles, and changes in foreign demand. The year-to-year variation caused by these factors often overshadows the influence of monetary actions.

Part of the inconsistency reflects the short time span in which most of the researchers were concentrating. Jacob Viner, prior to the predominance of the "New Economics," noted that economists tended to concentrate exclusively on long-run analysis [23]. Today, however, few are preoccupied with the effects that a given action will have in the more distant future. Most economists have moved to the other polar position, and accepted on faith Keynes' dictum that, in the long run we are all dead. Hence, public actions tend to be viewed on the basis of their immediate impact rather than their longer-run consequences.[1]

I adhere exclusively to neither view, but suggest that we are continuously experiencing both the short-run and long-run effect of past actions —the short-run impact of recent actions as well as the impact of actions taken in the more distant past. Hence, an unambiguous discussion of the influence of monetary actions on agriculture requires a distinction between the two time periods. In my view failure to make this distinction is a cause of the confusion.

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[1] For example, see the *Record of Policy Actions* of the Federal Open Market Committee in 1972. Major Committee objectives, such as the ease or tightness of bank reserves, current money market conditions, or current international developments were consistently of a short-run nature [2].

Money and Business Cycles

This article assumes that the trend rate of monetary growth is largely responsible for average price movements in the economy and that variations from the trend have a major influence on the cyclical movements of total output.

This view is based on the interaction of the demand for and supply of money. It holds that demand for money arises as a result of the services that money provides; that is, money facilitates transactions and serves as a store of purchasing power. The quantity of money that people desire to hold depends on income, wealth, interest rates, prices, and price expectations. On the other hand, the supply of money is largely under the control of the Federal Reserve System. The System through its open market operations can control the trend growth of the money stock.

If the quantity of money held by the public is greater than desired, the rate of spending will increase until income, wealth, prices, interest rates, and other factors which determine money demand adjust to the larger stock of money. During this period of adjustment total demand for all types of assets, including goods and services, will rise. Production and employment will be stimulated as inventories decline to less than desired levels. Over the longer run, as the economy approaches its productive capacity, excessive monetary growth will result only in price increases, wealth transfers, and inefficiencies caused by the implicit tax on money.

Considerable evidence has been gathered to support this monetary view. Research conducted at the Federal Reserve Bank of St. Louis, as well as elsewhere, has demonstrated that marked and sustained changes in the rate of monetary growth have generally preceded turning points in the business cycle [7, 8, 13, 24]. Sophisticated statistical analysis confirms the relationship between changes in the stock of money, total spending, and prices [1, 6, 11, 16]. It is not my purpose to rehash the evidence that money, business cycles, and inflation are related. I accept the evidence as presented that changes in the quantity of money are the dominant causal factors.

Impact of Business Cycles on Agriculture

Accepting the view that changes in the rate of monetary growth are the major cause of business cycles, the impact of such cycles on agriculture can, in turn, be either directly or indirectly attributed to monetary actions. The following hypotheses are advanced and will be tested as an aid to orderly discussion of such influences:

1. In the longer run, say five years or longer, monetary actions have about the same impact on farming as on the nonfarm sector. The trend growth in money is a dominant determinant of nominal farm income, farm expenses, and average farm product prices. All prices, however, eventually return to about their same relative positions, and with the exception of wealth transfers, monetary actions have little effect on real farm income or the well-being of farm people.
2. In the short run the farm and nonfarm sectors differ significantly in their adjustments to monetary actions.
    a. Farm output responds less and farm prices more than output and prices in the nonfarm sector.
    b. Farm output adjusts largely through changes in short-lived production inputs such as fertilizer and chemicals.
    c. Farm employment is more stable than nonfarm employment but sharper adjustments occur in farm wage rates.
    d. Farm income responds to monetary actions about the same as gross national product.
3. Interest rates charged farmers are less sensitive to monetary actions than rates charged some other major sectors of the economy.

Prior to the establishment of floating exchange rates, domestic monetary actions also had an impact on the foreign demand for U. S. farm products. With the fixed exchange rates in effect until mid-1971, domestic monetary actions which led to a higher rate of inflation in the United States than in other major commercial nations, tended to reduce foreign purchases of U. S. farm products and increase U. S. buying of foreign farm products. With the adoption of floating exchange rates, however, foreign demand for U. S. farm products is not greatly affected by domestic monetary actions and inflation. A rise in domestic prices is now offset by a decline in the exchange value of the dollar.

Longer-Run Impacts

Agriculture and the nonfarm sector of the economy probably make about the same fundamental adjustments in response to monetary actions in the long run.[2] If resources are fully utilized and production techniques are unchanged, the rising demand for goods and services caused by an increase in the stock of money will not lead to increases in output or major changes in relative prices. To meet this rising demand caused by monetary actions, producers will bid for scarce resources—land, labor, and capital, and resources will be channeled via prices, wages, rents, and interest rates to those uses where returns are highest. But with the same quantity of resources required to produce each product, prices of each resource will be bid up about the same percent. Producers will be willing to produce about the same quantity of goods and services and pay approximately the same real wages, rents, and interest. Hence, relative prices and real supply will not change much.

Consumer tastes and preferences, the other determinants of the production mix, are likewise not affected by rising total demand. Consumers have more dollars to spend, but the larger stock of money will purchase no more utility or well-being than the smaller stock of money would purchase earlier. Consequently, if the mix of the earlier purchases maximized well-being, the same quantity of each good and service should maximize well-being after inflation, assuming no major change in wealth distributions. Hence, no major gains or losses will accrue to agriculture or to any other sector of the economy, except for the possible impact of wealth transfers.

Unanticipated inflation caused by monetary growth results in transfers of wealth from monetary creditors to monetary debtors. Most farmers are probably net monetary debtors and thereby receive "windfall" gains from inflation. The farm finance data, however, exclude farmers' holdings of such assets as life insurance, savings and loan shares, corporate debt, and mortgages [17]. Furthermore, a balance sheet for retired farm people might show a net monetary creditor position. Consequently there is no assurance that farm people gain during their life span from changed debtor-creditor relationships caused by inflation. Younger farmers are net monetary debtors and hence, net gainers, while retired farmers may be net monetary creditors, thus net losers.

Short-Run Output Adjustments

Movements of key variables during the National Bureau of Economic Research (NBER) business cycles indicate that farmers have responded to monetary actions in the hypothesized manner. Total farm output, after adjustment for trend, declined from peak to trough in nine of the 10 economic recessions and rose from trough to peak in seven of nine recoveries since 1920 (Table 1). Farm output declined in each of the major recessions (those during which the industrial production index declined more than 10 percent per year—1920–21, 1929–33, and 1937–38) and rose in each recovery following these recessions.

The cyclical movements in farm inputs were generally in the same direction as farm output, indicating that the output response was planned and not a random occurrence. Total inputs, after adjustment for trend, declined in eight of the 10 recessions and rose during seven of the nine recoveries. The decline averaged 1.3 percent per year during the recessions, and the rise averaged 0.6 percent per year during the recoveries. Total inputs declined 2.0 percent or more per year in each of the three major recessions and rose 0.6 percent or more per year in each recovery which followed.

Inputs of fertilizer and liming materials are a more sensitive indicator of the farmer's response to changes in demand than total farm inputs. Farmers, like other businessmen, attempt to maximize wealth over time by adding resources until the marginal costs of all inputs are equal to their marginal value product. However, significant adjustments for a number of relatively fixed farm inputs, such as land, labor, and machinery, cannot be made over the course of most business cycles without major losses. On the other hand, fertilizer adjustments can be readily made in response to changing demand and supply conditions, since it is added annually and has little residual value.

Total fertilizer and lime usage, after adjusting for trend, was down in eight of the 10 recessions and up in seven of the nine recoveries. The decline averaged 8.7 percent per year for the 13 years of business decline, and the increase averaged 3.8 percent per year during the 30 years of business recovery. Declines of 7 percent or more per year occurred in each of the three major

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[2] During a correctly anticipated inflation the implicit tax on money bears heavier on economic activities that are relatively labor intensive. Consequently, the real demand for labor falls and real wages decline, while demand for capital rises and capital formation increases [12, p. 537].

Table 1. Changes in farm output and inputs during business cycle stages[a] (Compound annual rates of change)

Contraction Period	Total Output	Inputs: Total	Inputs: Fertilizer and Lime	Expansion Period	Total Output	Inputs: Total	Inputs: Fertilizer and Lime
1920–21	−11.5%	−3.4%	−27.8%	1921–23	+3.2%	+0.9%	+ 9.0%
1923–24	− 1.4	+2.0	+ 3.9	1924–26	+1.2	+1.4	+ 3.3
1926–27	− 1.4	−2.3	− 8.4	1927–29	−0.6	+1.4	+ 8.3
1929–33	− 2.6	−2.0	−15.9	1933–37	+2.6	+0.6	+16.1
1937–38	− 4.2	−3.4	− 7.0	1938–41	+1.5	+2.0	+ 5.0
1948–49	− 2.5	+0.8	− 0.2	1949–53	+0.3	+0.3	+ 0.8
1953–54	− 1.4	−1.2	− 1.2	1954–57	−0.7	−1.2	− 5.0
1957–58	+ 6.1	−0.2	− 4.0	1958–60	+0.9	−0.7	− 1.1
1960–61	− 1.4	−0.2	+ 0.2	1961–69	+0.3	+0.6	+ 1.1
1969–70	− 2.4	−1.2	− 4.5				
Number of years	13	13	13		30	30	30
Average rate	− 2.3%	−1.3%	− 8.7%		+0.9%	+0.6%	+ 3.8%

[a] Excludes World War II and early post-war years. Data are compound annual rates of change during the periods, adjusted for trend rates of change from 1920 to 1970 except for fertilizer and lime which was adjusted for trend rates of change from 1920 to 1940 and 1940 to 1970 [18]. Years in which NBER trough and peak months occurred are used as reference cycle dates [14].

business downturns, and increases of 5 percent or more per year occurred in each of the recoveries which followed.

Farm output adjustments over the course of the business cycles were found to be smaller on average than adjustments in the nonfarm sector.[3] Farm output decreased an average of 2.3 percent per year in the 13 years of business decline. In contrast real GNP decline averaged 6.6 percent per year and industrial production 12.7 percent per year (Table 2). In the years of increasing business activity, farm output increased an average of 0.9 percent per year compared with increases of 2.7 percent and 6.4 percent for real GNP and industrial production, respectively.

Special Factors Caused Greater Stability of Farm Output

The slower rate of farm output adjustment to changes in business conditions may be traced to a number of special factors including the method of committing farm resources and the structure of farming. Agriculture is by nature largely seasonal, and production plans must conform to seasonal weather. Cropping plans and resource commitments must be made in time to permit planting, cultivating and harvesting; and once made, such commitments cannot be readily changed without sizable losses. Livestock production plans are made for even longer periods than crops.

Typical farms, in contrast to large nonfarm firms, have the entrepreneurial function, labor and capital all vested in one person. Most farms are not able to make major labor adjustments without going out of business since the owner's labor often constitutes most of the labor input. Cash outlays are relatively low and a high percentage of the total costs are fixed. Consequently, farmers must take a long view and are apparently willing to produce for considerable periods of time at below average rates of return on labor and capital in other lines of production. Farm workers have chosen to accept lower wages in the short run rather than search for other jobs or accept unemployment. In contrast, the larger nonfarm firms which have ownership and labor vested in different people find it easier to adjust to declining demand in the short run by laying off workers rather than by reducing wages and prices. In many cases such firms are bound by wage contracts which prevent wage reductions, and output must be reduced through layoffs.

The impact of the special factors on farm output may have declined in recent years. As pointed out by D. Gale Johnson, in recent years farms have become more like nonfarm firms [10]. Purchased inputs in farming have increased, rising from an average of 49 percent of gross farm income in 1910–14 to 71 percent in 1972. Furthermore, expenditures on variable cost items such as seed, feed, fertilizer, and other chemicals have risen sharply relative to total costs. These out-

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[3] Professor Theodore W. Schultz also found that farm output is more stable than nonfarm output, but that farmers do make sizable adjustments in response to changes in demand [15].

Table 2. Changes in industrial production and gross national product during business cycle stages[a] (Compound annual rates of change)

Contraction Period	Industrial Production	Real GNP	Expansion Period	Industrial Production	Real GNP
1920–21	−27.1%	− 5.9%	1921–23	+19.0%	+5.8%
1923–24	− 9.8	− 0.6	1924–26	+ 3.8	+0.8
1926–27	− 4.0	− 2.7	1927–29	+ 3.5	0
1929–33	−14.8	−12.3	1933–37	+ 9.0	+5.9
1937–38	−25.1	− 8.7	1938–41	+17.5	+7.4
1948–49	− 9.4	− 3.5	1949–53	+ 5.0	+2.6
1953–54	− 9.3	− 5.0	1954–57	+ 2.0	0
1957–58	−10.5	− 4.7	1958–60	+ 2.9	+0.8
1960–61	− 3.2	− 1.7	1961–69	+ 2.5	+1.2
1969–70	− 7.7	− 4.0			
Number of years	13	13		30	30
Average rate	−12.7%	− 6.6%		+ 6.4%	+2.7%

[a] See Table 1 for description of methods used. All rates adjusted for 1920–70 trend [3, 5, 14, 21].

lays rose from 32 percent of average farm income in 1910–14 to 49 percent in 1972. An increase in such inputs, which are adjusted more quickly to reflect their changing marginal value product than inputs with greater fixity, tends to make farm output more responsive to monetary actions than heretofore.

The methods used in this study, however, did not pick up a faster rate of farm output response to changed business conditions in recent years. For example, total farm output has moved countercyclically three times since 1920, two of which have occurred since World War II (Table 1). Fertilizer and liming inputs have moved countercyclically four times, three of which have occurred since World War II.

The failure of agriculture to respond as consistently to business conditions in recent years as in the pre-war period may reflect the mildness of the recent business cycles and government farm programs. As indicated in Table 2, the post-World War II cycles have been relatively mild—the sharpest annual rate of decline in industrial production being 10 percent compared with rates of decline of 27, 15, and 25 percent in the downswings of 1920–21, 1929–33, and 1937–38, respectively. Upswings in industrial production have likewise been more moderate in the post-war period, the steepest rise being 5 percent per year in 1949–53. In contrast, increases of 19, 9, and 17.5 percent per year occurred in the pre-war upswings of 1921–23, 1933–37, and 1938–41, respectively. The annual rate of change in real GNP has not exceeded 5 percent per year since 1948 whereas higher rates of change occurred during each of the major pre-war downswings and the upswings which followed.

Since 1948 government farm programs have been more effective in isolating agriculture from general business conditions than in pre-war years. Such programs, prior to 1933, had little impact on either farm output or prices, and through 1941 government price support levels were relatively moderate. The quantity of farm products purchased through price support operations was relatively small, and the Commodity Credit Corporation (CCC) loan rate was generally below the market price for most major commodities. Since the mid-1950s, however, the CCC loan rate has frequently been above the market price, and the government has been the residual purchaser of products which failed to clear the market at the support price level. In some years crops held by the CCC as a result of such operations have totaled 40 percent of the value of all crops sold, and holdings of individual crops have exceeded their annual production. In addition, major domestic food consumption and export subsidy programs have been factors in reducing the effect of monetary actions on agriculture since World War II.

Farm Price Adjustments

Agricultural prices have greater procyclical movements than prices in the nonfarm sector, but farm price movements were less consistent as a result of the instability caused by nonmonetary factors. Farm prices fell at an average rate of 11.4 percent per year during the downswings since 1920, compared with rates of 6.1 and 3.8 percent, respectively, for wholesale and consumer prices. During the upswings farm prices increased at an average rate of 3.2 percent per year, compared with rates of 1.5 and 0.4 percent, respectively, for wholesale and consumer prices. Farm prices declined more than 17 percent per

Table 3. Changes in farm and nonfarm prices during business cycle stages[a] (Compound annual rates of change)

Contraction Period	All Farm Products	Wholesale Prices Industrial Commodities	Consumer Prices All Items	Expansion Period	All Farm Products	Wholesale Prices Industrial Commodities	Consumer Prices All Items
1920–21	−41.8%	−35.5%	−12.0%	1921–23	+ 6.4%	−0.4%	−3.7%
1923–24	+ 0.1	− 5.0	− 1.1	1924–26	+ 0.1	−0.4	+0.4
1926–27	− 4.0	− 6.5	− 3.2	1927–29	+ 2.2	−1.9	−2.0
1929–33	−17.7	− 6.6	− 8.0	1933–37	+14.3	+4.1	+1.3
1937–38	−21.1	− 4.5	− 3.2	1938–41	+ 7.9	+2.4	+0.2
1948–49	−13.5	− 2.6	− 2.3	1949–53	− 0.1	+2.5	+1.6
1953–54	− 4.1	− 0.3	− 0.8	1954–57	− 2.1	+2.7	+0.2
1957–58	+ 5.8	− 0.2	+ 1.4	1958–60	− 2.8	+0.4	−0.1
1960–61	− 0.2	− 1.0	− 0.3	1961–69	+ 1.1	+0.9	+1.3
1969–70	+ 1.2	+ 3.3	+ 4.6				
Number of years	13	13	13		30	30	30
Average rate	−11.4%	− 6.1%	− 3.8%		+ 3.2%	+1.5%	+0.4%

[a] See Table 1 for description of methods used. All rates adjusted for 1920–70 trend [5, 14, 17, 20].

year in each of the major business recessions and rose more than 6 percent per year in each recovery which followed. Crop and livestock prices moved at about the same average rate on both the upside and the downside of the cycles. Prices received by farmers, after adjusting for trend, declined during seven of the 10 recessions and rose during six of the nine recoveries (Table 3). In comparison, wholesale industrial commodity prices declined in nine of the recessions and rose in six of the recoveries, and consumer prices declined in eight of the recessions and rose in six of the recoveries.

Employment and Wages

As indicated earlier, monetary actions have had relatively little impact on farm employment since 1920. Hours worked on farms declined during most of the business downswings, but the decline averaged only 0.5 percent per year and the number of hours worked actually increased during the major 1929–33 depression (Table 4).

Table 4. Changes in farm and manufacturing labor and average wage rates during business cycle stages[a] (Compound annual rates of change)

Contraction Period	Farm Workers		Manufacturing Employees[c]		Expansion Period	Farm Workers		Manufacturing Employees[c]	
	Hours Worked	Wage Rates[b]	Number	Hourly Wage Rates		Hours Worked	Wage Rates[b]	Number	Hourly Wage Rates
1920–21	−5.2%	−38.4%	−23.7%	−10.9%	1921–23	+4.7%	+1.9%	+10.5%	−3.0%
1923–24	+3.7	+ 2.7	− 7.3	+ 1.1	1924–26	+3.8	−2.8	+ 1.3	−3.6
1926–27	−1.3	− 2.5	− 2.7	− 3.3	1927–29	+3.1	−2.6	+ 2.3	−2.3
1929–33	+1.9	−20.2	−10.0	− 9.7	1933–37	+2.1	+6.9	+ 8.7	+5.3
1937–38	−4.3	− 2.3	−13.7	− 3.2	1938–41	+1.7	+2.0	+10.6	+1.5
1948–49	−1.1	− 5.8	− 8.5	+ 0.1	1949–53	−1.0	+1.4	+ 3.8	+2.3
1953–54	−2.1	− 3.7	− 8.2	− 1.4	1954–57	−3.4	−0.1	+ 0.5	+1.1
1957–58	−2.0	− 0.2	− 8.4	− 0.8	1958–60	−1.0	+1.8	+ 1.4	−0.2
1960–61	−1.4	− 1.5	− 4.0	− 1.0	1961–69	−1.6	+2.8	+ 1.5	+0.4
1969–70	0	+ 4.1	− 5.2	+ 1.6					
Number of years	13	13	13	13		30	30	30	30
Average rate	−0.5%	− 9.9%	− 9.4%	− 4.4%		+0.3%	+1.9%	+ 4.2%	+0.8%

[a] See Table 1 for description of methods used. All rates adjusted for 1920–70 trend [14, 17, 18, 20, 22].

[b] Hired labor only.

[c] Production workers only.

In contrast to the stability of farm employment, average farm wage rates declined almost 10 percent per year during the 13 years of declining business since 1920 and rose 2 percent per year during the 30 years of business recovery. Such wages dropped 38 percent during the 1920–21 recession and an average of 20 percent per year during the 1929–33 depression.

In contrast to relatively stable employment and unstable money wages on farms, employment was unstable and money wages relatively stable in the manufacturing sector during the course of the business cycles. Manufacturing employment declined at an average of 9.4 percent per year during the years of declining business and declined 10 percent or more per year during each of the major recessions. Manufacturing wage rates, however, declined at an average rate of only 4.4 percent per year during all the recessions. During the business upswings, manufacturing employment rose more sharply and wage rates more moderately than in farming.

Income

Both gross and realized net farm income have followed procyclical courses somewhat similar to that of nominal GNP since 1920. During the 1920–21 and the 1937–38 business downswings, both gross and net farm income dropped more sharply than GNP, but in the more prolonged 1929–33 depression these measures of farm income and GNP declined at about the same rate (Table 5).[4] On the upside of the cycles both measures of farm income showed more moderate gains than GNP, reflecting, in part, the post-World War II adjustments to more normal domestic and export food demands. Export demand for U. S. farm products slackened somewhat during the period of domestic business expansion in the late 1940s and early 1950s as the war-torn economies in Western Europe and Asia regained their prewar production levels.

Monetary Actions and Farm Finance

Expansive monetary actions tend to reduce interest rates temporarily, but cause an increase in rates over the longer run. Consequently, any effort on the part of the monetary authorities to reduce interest rates today by increasing the growth of money will result in higher rates a few months ahead. The increased stock of money will have an impact on prices and the expected rate of inflation, which after a few months will result in higher interest rates.

Nominal interest rates will eventually approach the rate of inflation plus the real rate of return on savings [25]. Both supply and demand factors tend to increase interest rates during periods of rising prices. Demand for credit will rise as borrowers observe opportunities for investing funds in assets that they expect to appreciate in value. The amount of loan funds supplied will, in turn, tend to decline as savers find opportunities for more profitable investments directly. The rising demand for, and declining supply of, loan funds during rising price expectations will thus reach an equilibrium position when the rates rise to levels equal to the expected rate of inflation

Table 5. Changes in realized gross and net farm income and nominal GNP during business cycle stages[a] (Compound annual rates of change)

Contraction Period	Realized Gross Farm Income	Realized Net Farm Income	Nominal GNP	Expansion Period	Realized Gross Farm Income	Realized Net Farm Income	Nominal GNP
1920–21	−36.4%	−46.3%	−21.7%	1921–23	+4.8%	+12.9%	+ 7.9%
1923–24	+ 2.6	+ 3.2	− 3.2	1924–26	−0.3	+ 4.5	+ 5.6
1926–27	− 2.2	− 2.2	− 6.3	1927–29	−0.3	+ 2.0	+ 3.5
1929–33	−18.4	−20.8	−19.2	1933–37	+9.6	+15.5	+12.9
1937–38	−14.5	−22.8	−11.2	1938–41	+8.6	+12.0	+13.7
1948–49	−11.3	−15.4	− 5.3	1949–53	0	− 0.6	+ 9.2
1953–54	− 6.6	−14.1	− 4.8	1954–57	−2.8	− 7.2	+ 6.5
1957–58	+ 9.1	+17.8	− 3.5	1958–60	−1.7	− 3.8	+ 6.1
1960–61	− 0.1	+ 0.5	− 1.6	1961–69	+1.3	+ 0.8	+ 7.5
1969–70	+ 2.0	− 0.8	+ 0.1				
Number of years	13	13	13		30	30	30
Average rate	−10.1%	−12.6%	−10.3%		+2.4%	+ 3.7%	+ 8.5%

[a] See Table 1 for description of methods used. Farm income data excludes government payments. All rates adjusted for 1920–70 trend [14, 19, 20, 21].

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[4] These results are generally consistent with the findings of William Gramm and Robert Nash [9].

plus a normal real rate of return. Farm financing costs will reflect monetary actions over the longer run in the same manner as nonfarm financing costs. Farmers must eventually pay a real rate of interest plus an additional increment equal to the expected rate of inflation.

In the short run, however, interest rates charged farmers neither rise nor fall as rapidly as rates charged other borrowers. Interest rates on most farm loans were about the same or higher than rates on business loans in early 1972. But following the uptrend in rates in early 1974, rates on business loans were generally higher than rates charged farmers.

This tendency of rates charged farmers to lag other rates may be caused partly by the lower lending margins charged by the Farm Credit Banks during periods of rising interest rates than during periods of declining rates. The smaller commercial banks which are the major farm lenders are also reluctant to change rates, although this reluctance may be weakening, in view of the expanded participation of smaller banks in the Federal funds market.

Summary

In summation, the long-run impact of monetary actions on agriculture is about the same as on other sectors of the economy. Trend movements of output and real income are largely determined in both sectors by non-monetary factors such as natural resources, the labor force, capital, technology, and consumer preferences. The dominant influence of monetary growth in the long run in both sectors is on average prices.

In an unanticipated inflation, wealth is transferred from creditors to debtors. Hence, the wealth of those farmers who are net borrowers is increased and that of net lenders is reduced. But farm people, including retired farmers, during their life span may be neither major net gainers nor net losers as a result of such transfers.

In the short run pronounced variations of monetary growth around a trend rate is the dominant cause of business cycles, and the magnitude of the adjustments in the farm and nonfarm sectors during business cycles is substantially different.

Farm output tends to adjust at a lower rate than output in the nonfarm sector, but the average movement of farm output was generally below the trend rate during the downswings in business cycles and above the trend rate during the upswings. Farm inputs also followed a similar pattern, and variable cost input items such as fertilizer and liming materials were more procyclical than total farm inputs.

Very little cyclical adjustment occurs in farm employment, possibly reflecting the greater fixity of farm than nonfarm labor, and the rising unemployment and difficulty of finding jobs in the nonfarm sector during business declines.

Farm wage rates adjust sharply to cyclical changes in demand. In contrast, in the manufacturing sector wage rates are relatively stable and employment makes a greater procyclical adjustment.

Farm commodity prices adjust sharply to shifts in demand, moving procyclically at about twice the rate of change for wholesale industrial prices.

Farm income adjustments are not significantly different from nominal GNP adjustments. On the downside of the cycles realized gross farm income declined at about the same rate as GNP and realized net farm income at a slightly faster rate, but on the upside of the cycles GNP rose at a faster rate than farm income, possibly reflecting early post-World War II adjustments in world agriculture.

Monetary actions probably have less impact on farm finance than on nonfarm finance over the course of most business cycles. Interest rates charged farmers do not change as much as rates charged other borrowers during the course of business cycles. Over the longer run, however, all borrowers must pay the rates caused by monetary actions which lead to changes in anticipated inflation.

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Farm Finance and National Economic Policy— Some Gaps in Knowledge*

JOHN R. BRAKE

SEVERAL YEARS AGO an AAEA committee was charged with initiating reviews of research in various fields of agricultural economics. That committee subsequently commissioned agricultural economists to review the literature since World War II in these various fields and to report on the status of knowledge to the profession. Emanuel Melichar, with the Board of Governors of the Federal Reserve System, and this paper's author are involved in a review of agricultural finance literature. This paper builds on materials that have been reviewed.

This paper does not fully treat the broad subject of farm finance as related to national economic policy. Omitted are issues of taxation, price stabilization, loan guarantees, business cycle relationships to agricultural credit markets, differential effects of inflation on agriculture and other sectors, and others. Although such issues merit further research and discussion, the purpose here is to focus on a relatively few important topics, to review research on those issues, and to suggest gaps in knowledge.

The basic assertion made in this paper is that agricultural finance research is too heavily oriented toward micro economics and not sufficiently concerned with national economic policies. While micro economics is important and should receive reasonable emphasis, it is also true that national economic policies affect capital formation in agriculture, functioning of financial markets in rural areas, and the flows of funds between agriculture and other sectors. To the extent this assertion is valid, it is, perhaps, largely because of agricultural economists' training in economic theory. Undoubtedly most agricultural economists have received more exposure in micro theory than in macro theory. Another possible reason for this micro orientation is that micro theory suggests more easily tested hypotheses than macro theory.

There is, perhaps, danger in overemphasizing the importance of economic theory with respect to research results. However, this position stems from the methodological importance of theory in specifying the main economic relationships of relevance in research. Economic theory provides the basis for delineating hypotheses to be tested and specifying the relationships to be measured. In many cases gaps in our knowledge of agricultural finance issues stem directly from gaps in the underlying economic theory.

The four topic areas discussed here are: (1) capital formation in agriculture as affected by national economic policy; (2) the effect of national monetary and credit policies on investment and production in agriculture; (3) functioning of rural financial markets; and (4) the sources and uses of funds approach in the analysis of agricultural financing.

Capital Formation in Agriculture as Affected by National Economic Policy

A classic study of capital formation in agriculture by Tostlebe [33] cover the 1870–1950 period. This study concluded that major amounts of farm capital came from public land grants and savings from gross income of farmers. A relatively minor part came from credit institutions. In current dollar terms, inflation added much of the farm capital value—particularly from 1910 to 1950.

Kuznets [20], in a companion study to Tostlebe's, examined capital formation and financing in the American economy. He suggested that a main determination of capital formation is to be found in factors affecting the savings process rather than exclusively in the demand for capital funds. He argued the need for theoretical work to explain the levels and trends in the proportion of capital formation to national product because his research showed a decreasing proportion of capital formation to national product over the 1869–1955 period.

In a review of the Kuznets' effort, Paul [24] pointed out the importance of the shift in capital formation toward households as private automobiles replaced public buses and as other labor and time-saving devices were purchased by households.

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A more recent extensive review of capital formation worldwide was undertaken by OECD [9]. A general discussion of capital formation in agriculture is presented with a review of factors which affect capital formation including brief reference to governmental efforts as well as individual incentives for capital investment. The OECD effort updates the U. S. agricultural capital situation through 1969 utilizing data from USDA situation reports [10]. In the studies mentioned to this point, emphasis has been on description of historical capital stocks and their changes with relatively little attention to the effects of national economic policies on capital formation.

Perkins and Witt [26] concluded that capital formation may take quite different forms depending on the stage of agricultural development. When agriculture is characterized by unused resources, scarce capital, and surplus labor, a major part of capital formation occurs in the form of nonpurchased capital produced with surplus labor. In a second stage of development when there exists little slack in unused natural and labor resources, social overhead capital investments become relatively more important. In a third stage of development characterized by American agriculture, they expected capital formation would occur concurrently as a substitute for labor, for resource development, and for infrastructure and social overhead.

Johnson [18] described factors affecting agricultural capital formation as follows: (1) Farm capital formation takes place rapidly when farmers are in a position to gain from reinvesting part of their income and when they have the responsibility for the investment decision concerning farm production. (2) Rapid capital formation occurs when the public makes substantial investments in both the general and technical education of farmers, in improved technology for farming, and in extension of that technology to farmers. (3) Formation of farm capital is accelerated when the transfer of capital from farm to the nonfarm sector is left to voluntary processes, including transfers in the form of inherited, monetary capital as well as training received by farm children who migrate to nonfarm occupations. (On the other hand, programs designed to force income out of agriculture make private agricultural investment unattractive.) (4) Lagging farm capital formation can be stimulated with favorable price programs and credit assistance to individual farmers. (5) Both publicly and privately managed systems of direct agricultural production tend to be characterized by underinvestment in public facilities for agricultural research and extension, in general education, and in roads and other public facilities.

Some of Johnson's conclusions deserve further testing; however, they do provide a broader perspective on capital formation than is typical of most writings. In contrast to this broader view of capital formation in relation to economic policy, agricultural economists in general have tended to use micro economics as their guide in research on capital formation. Reference to recent research is illustrative.

Baker and Hopkin [2] suggested a model for farm capitalization which related growth of the farm firm to rate of return on assets, financial leverage, and the farm family consumption function. They postulate that the incentive for a farmer to invest in his farm, to borrow for investment, or to save from consumption stems directly from the rate of return he can obtain in his business. Similarly, Adams and Singh [1] focused on the firm-household decision making process as being vital for explaining rural capital formation. Tinnermeier [32] also reminds us that for small farmer credit programs to be successful, new technology must be profitable for the small farmer.

Johnson and Quance [19] explain agricultural capital formation in an economic framework of (1) substitution of capital inputs for labor and land in response to rising wage rates and rising land values, and (2) response on the part of farmers to expected MVP's for capital investment that were in excess of acquisition costs. Their study concluded that overcommitment of capital in agriculture resulted because *ex post* MVP's were lower than *ex ante* MVP's.

The studies of Baker and Hopkin, Adams and Singh, Tinnermeier, and Johnson and Quance represent useful thoughts and research. They do, however, illustrate the tendency to rely on micro economics and neglect macro economics in the search for explanations of capital formation.

This section suggests that theoretical and problem oriented research would be useful in relating capital formation in agriculture to national economic policies and programs. Does capital formation (increased productive capacity) in agriculture take place primarily in the context of the individual entrepreneur's adjustment to changing input and product prices? Or are there also important effects on the rate and type of capital formation due to actual or potential national economic policies (e.g., continued inflation, tax legislation, expensive credit policies)? Further, what can be said about the importance and appropriateness of infrastructure and social overhead capital formation as it relates to agriculture and to agricultural development?

It is this reviewer's conclusion that there are significant gaps to our knowledge concerning the relationships between national economic policy and capital formation in agriculture. There would also seem to be some potential for relating agricultural capital formation in the U. S. to the international economic situation. What are the implications of flexible exchange rates or shifts in balance of payments toward oil producing countries for American agriculture?

Effects of National Monetary and Credit Policies on Agricultural Investment and Production

Only limited agricultural finance literature exists which evaluates national monetary and credit policies with respect to agriculture. One early effort was by Doll [13]. His empirical analysis of the 1950s concluded that easing of monetary conditions, e.g., increasing the money supply, would not be beneficial to agriculture. He found the relationship between money supply and farm prices received to be inverse and statistically poor during the 1947–57 period. Further, the comparison of farm costs and monetary conditions did not encourage easy money policies as a method to reduce farm costs.

Contrary to Doll's results, Gramm and Nash [14] found that agricultural incomes and investments have been responsive to changes in the money supply in the same manner as nonfarm incomes and investments. The elasticity of farm and nonfarm incomes in response to money supply changes were similar and statistically significant over the 1919–1966 period. However, while farm investments were related to changes in the money supply, the elasticities of farm and nonfarm investments relative to changes in the money supply were not equal. They suggested the difference might be due to relatively more inflexible interest rates faced by the farm sector. They concluded that farm policy "might be more effective if it were more closely coordinated with overall monetary and fiscal policy."

Sharpe [29] examined the impact of tight credit on farm mortgages during 1963–69, a period during which interest rates on farm mortgage loans rose from about 6 percent to almost 9 percent. During this period, individuals as lenders increased their share of the total real estate credit market. Federal Land Banks also expanded their share of the market. Commercial banks increased their farm mortgage loans more slowly than Federal Land Banks. Insurance companies reduced their loan commitments.

Trimble [34] looked at the effect of the stringent monetary and credit policies of 1969 and 1970 on the cattle industry. He hypothesized that these monetary and credit policies contributed to the higher farm level beef prices of 1973 through decreased investments in productive capacity or through excess herd culling in reaction to 1969–70 conditions. His empirical results show that the beef cow herd expansion rate did relate to monetary and credit conditions. However, the estimated effect of monetary and credit policies was relatively minor. Only 5 percent of 1973 beef prices were explained by 1969–70 credit conditions.

Relatively little research has been done to examine the effects of national economic conditions and policies on the agricultural sector. The current rapid rate of inflation needs more study in terms of its effects on agriculture. Moreover, anti-inflationary economic policies need analysis concerning their impacts on the agricultural sector. Are there types of agricultural enterprises where anti-inflationary policies, such as expensive credit policies, create more difficulties than they solve? Such policies are designed to discourage the demands for goods and services, but might there be some production processes where such policies discourage investment in production capacity rather than demand for produced goods and services? In other words, are there agricultural situations where national economic policies designed for the general economy have an undesirable effect on the agricultural sector?

Research on Rural Financial Markets and Their Functions

There are substantial knowledge gaps concerning the functioning of rural financial markets. Typically, two types of studies have added to the understanding of such markets. One type has studied individual institutions. Examples are many, including Carson [11], Hopkin and Frey [17], and Hoffer, Boek, and Boek [16]. Such studies have typically described how the institution operates, who it serves, and the problems it has experienced.

The second type of study has put emphasis more on description and analysis of market functions. Nisbet [23] described the rural credit market in Chile as consisting of an institutional market and an informal credit market. The well-to-do farmers were served by the banks in the institutional market while poor farmers utilized the informal, higher cost, credit market.

The role of financial intermediaries has received increased emphasis and increased interest from researchers. Baker, Hopkin, and Brinegar [3] have called for additional research on financial intermediation. They argue that these financial institutions need to be modeled before much significant research can be done. They suggest financial intermediation can be viewed as buying funds with one set of maturities and selling funds with another set of maturities. They also have argued for the use of models to describe the functioning of financial markets.

More recently, Barry and Hopkin [4] have suggested a resource allocation model to examine the behavioral properties of financial intermediaries. Their model is basically a multiperiod LP approach including attention to liability management options, asset management options, and constraints. Particularly useful is the specification of data needs by the model. Payoffs, returns, and feedback coefficients are specified in a systematic manner. Without such a model some of these important relationships would be overlooked.

Much attention has been given to financial intermediation by Federal Reserve economists. A study by Swackhamer and Doll [31] examined the distribution of bank credit flows in relation to the economic and institutional environment. Their data suggested considerable immobility in bank credit flows in rural areas both by regions and through time. They also identified considerable inflexibility in interest rates.

Geographic location was found by Swackhamer and Doll to have a statistically significant and economically important association with the structure of farm loan rates. There was evidence of rigidity in agricultural loan rates for all types of farm loans. The small banks which paid very little for funds charged rates for farm loans that were about the same as larger banks which paid maximum savings rates.

Swackhamer and Doll noted that participation loans increased by a factor of seven in the decade before 1966. They viewed this as an attempt by banks to adjust to, and keep pace with, the increasing financial requirements of agriculture. Yet they questioned whether the participation loan has potential for meeting future agricultural credit needs.

Baughman [5] described the basic economic function of financial intermediaries as providing a linkage between suppliers and users of funds. He described the national financial market, a variety of instruments and institutions linking the national market to local markets, and the local market for farm securities. He then concluded that adequate credit has been available to agriculture since there have been rapid increases in investment per worker and in output per worker. Also, he argued that the low rate of return on capital in agriculture suggested easy capital availability. He concluded that financial intermediaries have performed their roles reasonably well.

Sloan [30] agreed that existing financial intermediaries have performed reasonably well. At the same time, he pointed to imperfections in financial markets. He cited as examples the relative inflexibility in the price of agricultural credit compared with the price of credit in other sectors of the economy and a significant disparity in interest rates on agricultural loans among geographical areas. Further, he suggested that the rapid increase in the proportion of credit held by noninstitutional lenders may be symptomatic of shortcomings in the money markets. He also stated that legal restrictions often interfere with the free flow of capital resources. He included in this category, prohibition on certain forms of structure such as branch banking, usury laws, and restrictions on interest rates paid by banks and other thrift institutions.

Brake [7] suggested that the market for rural savers may also have inadequacies. In many rural areas the alternatives for savers are extremely limited and often provide only relatively low returns. The quality of information and access to investment information are more limited in rural areas than in urban areas.

In another work on rural financial markets, Hayenga [15] analyzed the effects of rural bank mergers on the services offered to citizens of the rural community. As a result of bank mergers, customers had access to a wider variety of services from the bank. New services were offered by merged banks that were not offered by independent banks. Both the market for loans and the market for savings became more closely tied to money market conditions. With bank merger, loan eligibility requirements became more liberalized so that a wider range of people became eligible for loans.

The literature available on financial markets and institutions is heavily oriented toward (1) specific institutions, and (2) farm loan purposes. Studies contributing to a broader understanding of rural financial markets including not only loans but savings and exchange of financial debt and equity instruments as well as noninstitutional participants are few.

Baughman's analysis is suggestive of the kind of economic logic which could be applied to studies of financial markets. Sloan's discussion points out some suspected market imperfections which merit study. Certainly the time is ripe, as suggested by Baker, Hopkin, and Brinegar, to undertake some modeling of financial markets. Such modeling will require both more descriptive information than currently available and a more macro-oriented and analytical approach to financial markets than has been applied in the past. A useful first step in this direction with respect to financial institution modeling is the Barry-Hopkin article.

Sources and Uses of Funds as an Analytical Tool

The sources and uses of funds approach to financial analysis carries great potential for improving our understanding of the financing of agriculture. This approach was pioneered by Copeland [12], but its adoption as an analytical tool by both economists and agricultural economists has been very slow. Analytically, it is an attempt to describe the money transactions between one sector and others. The approach has an appeal to a micro economist based on a direct parallel between sources and uses of funds of an individual firm and of a sector. In another sense, the approach can be viewed as simply measuring the financial transactions or flows between two balance sheets.

Several years after Copeland's initial work the *Federal Reserve Bulletin* began to carry flow of funds data. Yet by 1968 Ritter [27] concluded that economists were generally not utilizing this approach for financial analysis. He called these data "indispensable" for understanding financial market interrelationships.

Perhaps the first explicit reference to this analytical tool in the agricultural economics literature was an article by Penson, Lins, and Irwin [25]. They recognized the potential usefulness of this approach in describing the changing financial structure of agriculture. They pointed out its potential value particularly if disaggregation could reveal uses of funds by various classes of users. They suggested that this framework had the potential to provide the basis for new policy determinations and for welfare comparisons that are not otherwise possible.

In a comment on the Penson, Lins, and Irwin article, Brake and Barry [8] took exception to some of their concepts and approaches. Although some of these differences are significant, Brake and Barry concurred that there exists substantial potential for analysis of the agricultural sector using the sources and uses of funds approach.

The flow of funds approach requires estimation of a matrix of numbers to quantify funds that come into the sector from various sources and the uses or payout of funds. In credit, for example, new borrowings from the various institutions represent sources of funds while debt repayment represents a use of funds.

This approach has been utilized in several models of the agricultural economy [6, 21, 22, 28]. Melichar [22] has developed a rather extensive model to examine financial aspects of the agricultural sector. The model estimates flows used for capital purchases, savings rates, internal financing, and projected external financing based on historical trends. The Penson model [21] is even more flexible in terms of utilizing the latest USDA projections to simulate changes in asset and liability items of the agricultural sector. This year the Penson model became the first sources and uses of funds model to be used in deriving official government forecasts of the agricultural sector.

Yet the sources and uses of funds approach is relatively untouched in agricultural finance. One need is for development of the underlying economic theory in the context of this tool. How do various uses of funds change with economic variables? How does agriculture, as a sector, make decisions on savings rates, new investments, and consumption? In the models using this approach, each estimate comes from an equation specified by the model builder. Undoubtedly these specified relationships need considerable additional discussion and analysis. Development of theory is needed for these relationships as well as for the sources and uses of funds framework to point the direction for continued research.

There is also need for additional conceptualization within the sources and uses of funds analytical framework. Some sources and uses of funds are not transactions in the usual sense. Included are gifts and inheritances. Capital appreciation and depreciation affect balance sheets but do not represent either flows of funds or transactions. Perhaps one of the most difficult conceptual problems is the change in people who are included in the agricultural sector. Each year a number of operators leave the sector and new entrants come in. Conceptualization is needed concerning the proper treatment of such changes.

This relatively new tool shows much promise, but there are substantial gaps in economic theory, analytical concepts, and data which need improvement if that promise is to be realized.

Concluding Comments

This paper has highlighted four important agricultural finance topic areas. It has asserted the need for additional macro emphasis in agricultural finance. Though the references cited do not, in and of themselves, verify the strong emphasis in the agricultural finance literature on micro as opposed to macro analysis, the AAEA literature review effort in agricultural finance does indicate that tendency.

This paper illustrates the knowledge gaps that do exist in four specific areas of agricultural finance. These are:

(1) gaps in knowledge of agricultural capital formation as affected by national economic policy,
(2) gaps in knowledge of effects of national monetary and credit policies on specific types of agricultural investment and production,
(3) gaps in research on rural financial markets and their functions, and
(4) slow adoption, and as yet little use, of sources of funds approach as an analytical tool.

Hopefully, the future will find agricultural finance researchers searching for a better grounding in macro economic theory and turning more of their attention to analyses of the effects of national economic policies on financial aspects of the agricultural sector.

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Sources and Uses of Funds in Agriculture

OLIN B. QUINN

WHEN ONE CONSIDERS the sources of funds in agriculture, those of us in the business of providing the funds through credit institutions immediately remember the credit crunch of 1966–67—when there was genuine concern as to whether funds would be available, at any price. As it turned out, credit demands were met but under restrictive terms for awhile. A good example of restriction was the time limitation placed on loan commitments—the borrower could have the funds today but not necessarily next week.

Today we have a different situation. The price has become the dominant factor, but there seems to be little question that funds will be available for agriculture. Perhaps the emphasis on food, and the cost of food, has made America realize that financing the farmer is a sound investment. Speaking to the Southern Farm Forum in Memphis earlier this year, Glenn G. Browne, General Partner, Quincey and Co., New York City (and former fiscal agent for the Farm Credit Banks), said: "The investors and savers of this country—although presently complaining about high food prices—nevertheless, historically have looked upon agriculture as a prime place to put their money. At a price, to be sure—but this is always the case in a free enterprise system where competition is the name of the game." Thus, if historically there has been faith in agriculture as a viable industry, then perhaps 1966–67 was an exceptional situation that ought not to trouble our forward thinking.

Mr. Browne also stated: "It is my own personal view, based on experience with the resourcefulness and ingenuity of the American farmer, that future problems will lie not in the output side of agriculture but with inputs such as machinery, fertilizer, storage, and transportation facilities, and with various kinds of energy. I distinctly do not place financial or farm credit resources, if you will, in the category of potential shortage."

On what basis are America's investors willing to pledge their savings to agriculture? In addition to their concern for adequate supplies of food and fiber, at reasonable prices, the investors have only to look at the financial structure of agriculture to recognize the soundness of the industry. According to figures published by the United States Department of Agriculture, on January 1, 1974, the balance sheet of U. S. Agriculture showed:

Assets	$454 billion
Debts	80 billion
Equity	$374 billion

How many business firms can produce a comparable statement?

Of course, as we examine dollar amounts these days, we must be ever conscious of the effects of inflation; but even with a shrinking dollar the amount of funds used in agriculture, as new funds and to refinance existing debt, is tremendous. As an illustration of the amount of funds used, at the beginning of 1974, institutions of the farm credit system held approximately 22 percent of the nonreal estate and real estate debt of agriculture—slightly more than one-fifth of the total—while in the prior 12 months these institutions issued $11.7 billion in bonds to finance this debt.

Sources of funds in agriculture are (1) retained earnings or savings from the industry itself, (2) borrowed funds, and (3) to a lesser extent, gifts or other free capital. Credit has been and will become an increasingly important source.

Let us take a minute to identify the types of institutions providing credit. First, we should distinguish between individual lenders and institutional lenders; and then perhaps in the institutional group, separate private sources of funds from public sources. In both nonreal estate and real estate lending, individuals continue to be important sources of funds—holding in excess of 40 percent of the debt over the past 20 years.

Institutional lenders vary by the type of debt. In nonreal estate debt, private lenders include, in order of rank: (1) individuals (including merchants, dealers, etc.), (2) commercial banks, and (3) production credit associations. Real estate debt is held by: (1) individuals, (2) federal land banks, (3) life insurance companies, and (4) commercial banks. The Farmers Home Administration is the principal lender of public funds for both nonreal estate and real estate purposes in agriculture.

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The term "nonreal estate debt" probably is a misnomer today as a description of the type of credit extended. Formerly, nonreal estate debt was associated with short-term production financing of crops, equipment, and livestock, secured by chattel mortgages but not real estate collateral. It has become a fairly common practice for short-term lenders to take a real estate mortgage as back-up collateral.

Availability of funds and interest rate are important considerations in the entry of firms into the credit market. During the 1966–67 credit crunch, there was pronounced decline in farm real estate loans by insurance companies. In 1973, with an inverse yield curve and when short-term rates exceeded long-term rates in the securities market, commercial banks became more active in nonreal estate (production loans) loans to farmers.

A feature that sets the Farmers Home Administration apart from the usual type of institutional lender is the farm management counsel associated with their loans. By providing the capital and the "know-how," the FHA assists low equity borrowers to reach a position to "graduate" from the public funds program to conventional private lenders as a source of continuing credit. Unfortunately, the funds available to the Farmers Home Administration depends upon an annual appropriation made by the Congress—and, in the past, funds are often depleted by mid-year or soon thereafter.

Reference has been made to the importance of individuals (including merchants and dealers) in financing agriculture. We are all aware of the amount of funds spent for production inputs which are financed as accounts receivables. In the real estate credit area, sales contracts (often family affairs) continue prominent—some as actual long-term loans and some as interim financing to be shifted to institutional lenders as necessary equity positions are attained.

Overall, individuals are a widely used source of agricultural credit. Frequently farmers borrow from landlords, relatives, and other individuals with surplus funds to invest. In some instances, individuals are a satisfactory source of credit, providing easy access to funds on reasonable terms. Generally, however, individuals are not a highly dependable source of credit over a period of time since death or changes in the personal or financial situation of the lender may result in a demand for repayment on short notice or uncertainty of future advances.

There are times when lenders cooperate or participate with each other in providing the credit needs of farmers. The Farm Credit Act of 1971 allows production credit associations to participate on loans with commercial banks; and in recent years, a participation agreement has been confirmed between the Federal Land Banks and the Farmers Home Administration. This latter participation can be useful—especially to young farmers—in providing credit in excess of the usual amount associated with equity requirements. Sales contracts with individuals often are made with the understanding that the contract will be paid by shifting the debt to an institutional lender after a certain number of years.

So far we have considered sources of funds for the individual farmer. An important area of agricultural finance is the farm cooperative—user-owned organizations which provide savings to the individual farmer-member through economy of size and advanced management techniques. In addition to actual credit cooperatives (as the farm credit system), other cooperatives often provide credit services to members through, e.g., account receivables.

Credit sources to the cooperative organization itself include commercial banks and the banks for cooperatives of the farm credit system. Due to the specialized nature of cooperative financing, lenders to cooperative organizations must, in themselves, be rather specialized—thus it is estimated that the banks for cooperatives of the farm credit system are currently supplying about 65 percent of the credit needs of farmer cooperatives in the United States.

From the borrower's viewpoint, what does he look for in a lender as a source of agricultural credit? We can begin with character—the lender's reputation for fairness and honesty. Does the lender understand agriculture and adapt credit terms to crop seasons, depreciation schedules, permanence of assets? Are there provisions in loan policies and repayment schedules to allow for abnormal price changes, severe weather, and other factors over which the borrower has no control? And—very important—will the lender be able to provide funds in a dependable fashion over periods of economic stress? What is the lender's source of funds?

So far we have discussed the sources of funds in agriculture—now let us consider the uses of funds. To begin, it would be rather academic to say that farmers need funds for fertilizer, feed, and to purchase the adjoining 80 acres. Perhaps a better approach to uses of funds in agriculture are the decisions that farmers must face in deciding to borrow money.

Again, we are confronted with the question: are funds available? If so, at what price? It has been my observation, over the past 20 years, that the first question is more important than the second. As a business organization increases its dependence on credit for sustained growth—even though the use of credit is sound—the ability to shift to a cash basis lessens almost to the point of disappearance. This phenomenon is not peculiar to the farm business. For example, only a few years ago in the Federal Land Bank of New Orleans, bonds outstanding represented 80 percent of the loan volume. Today this figure is 90 percent—due to the rapid growth in loans outstanding—as farmers use more and more credit. Taken another way, the accumulation of retained earnings continues to decline as a source of funds in an expanding industry. So, the farmer is first concerned about the supply of funds, and only secondly is he concerned about price (interest rate).

This does not mean that the farmer is always locked in—at the mercy of the lender. While his dependence on credit continues to grow, it is not necessarily 100 percent, and he has choices in (1) type of credit, (2) lenders, (3) to expand or not, etc. I believe that the type of credit should be related to the type of asset financed, from the standpoint of term repayment schedule and collateral. The characteristics of a suitable lender have already been outlined; therefore, with all things being equal, the farmer should consider differences in interest rates (if any) charged by respective lenders. Also, the type of interest rate program is important; for example, is the borrower willing to accept a variable interest rate?

Decisions to expand—to buy the adjoining 80 acres—involve the several choices already mentioned, plus market price. Can a person repay a loan to purchase land at $800 per acre at 8 percent interest? This means $64 per acre as "money rent" before any production inputs are added. And what about repayment of principal—the amount to be added each year certainly will vary with the term of the loan.

Earlier in this paper, there were cited balance sheet items for U. S. agriculture, indicating a fine equity position. This can be a pitfall for the individual farmer. With the continued, and often rapid, increase in land values, a farmer's equity position can improve "out-of-proportion" to income and debt repayment capacity. Thus, in making the decision to finance his operation with borrowed funds, the wise farmer must look beyond the balance sheet. He cannot repay debt with equity, unless he sells the assets.

Sources of funds, characteristics of lenders, type of loans, borrowers' decisions—all are part of the credit scheme which provides the bulk of financing in agriculture. Suppose there is a common viewpoint between borrower and lender, as should be true in cooperative organizations, that credit should be "sound" to both parties. On the corner of Magnolia and Palmetto Streets (fictitious) in New Orleans is the Friendly Loan Company (fictitious). The company has been in business at this location for 40 years and, apparently, will be for another 40. Over the years many accounts have been written off, but at 3.5 percent per *month* the overall credit position is "sound" for the company—but how about the unfortunate individual who has no choice but to borrow at 39 percent[1] per annum?

Finally, as this paper is being prepared, concern is developing in the financial arena about the possibility of another credit crunch. This is not surprising when one looks back over the past 18 months of unbridled inflation. Hopefully a solution can be found in reduced unproductive spending. One way to cure a portion of our economic ills is to assure adequate funds to agriculture—a productive industry. I agree with Glenn Browne—funds will be available.

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[1] This is the state limit.

Session 9

AGRICULTURAL FINANCE AND ECONOMIC POLICY

Discussants: Peter J. Barry, Texas A&M University; Marshall Burkes, Federal Home Loan Bank Board; Mona E. Dingle, University of Missouri

Session 10

AGRICULTURAL AND RURAL LABOR RESOURCES

CHAIRMAN: ROBERT D. EMERSON, UNIVERSITY OF FLORIDA

A Model of an Agricultural Labor Union*

GEORGE W. LADD

A VOLUNTARY ORGANIZATION—labor union, farmer cooperative, or business firm—is affected by both internal and external factors. An agricultural labor union is affected by acts of employers, general business conditions, and legislation, for example. It is affected by such internal factors as attitudes and desires of members and amount of support it receives from members.

Consideration of internal influences leads us into organization theory. The first section of this paper discusses determinants of the amount of support an organization will receive from its members in striving for given objectives. The amount of support an organization receives from its members, and its interaction with external forces, are affected by its objectives. The second section of this paper summarizes some ideas from a recent book on labor union goals. The third section presents my model of an agricultural labor union. The fourth section treats the relation between union and non-union wage rates.

Partial Model of an Organization

Several years ago some of us at Iowa State University did some research on bargaining power of organizations of farm operators. As part of that research, Milton Hallberg studied Grade A milk bargaining cooperatives [5]. As an aid to understanding behavior of cooperatives and cooperative members, he synthesized ideas on theory of organizations from March and Simon [8], on group dynamics from Cartwright and Zander [4], and on theory of intra-group interaction from Homans [6] to develop a partial model of an organization. The graphic synthesis in Figure 1 is copied directly from Hallberg's thesis [5, p. 60]. Hallberg dealt with determinants of members' support of an organization's goals. He did not deal in this analysis with determination of group goals, but assumed the group's goals could be identified, and investigated the performance of the group in achieving its goals.

The various boxes on the graph identify various forces affecting members' decisions to support the organization's goals. Arrows indicate directions of influence, and positive and negative signs indicate whether functional relationships are positive or negative. The next few paragraphs summarize Hallberg's discussion.

Several forces affect the amount of intragroup conflict within an organization. Existence of a highly heterogeneous membership contributes to intragroup conflict through divergences among individual goals and between individual and organizational goals and through differences in preferred methods of achieving these goals. Conversely, in small, homogeneous groups differences in individual goals are apt to be low, and, therefore, intragroup conflict is likely to be low. At the same time, however, members' mutual dependence on limited resources may be greater in small organizations than in large organizations. When mutual dependence on limited resources among members increases, the amount of felt need for joint decision making will increase, resulting in increased intragroup conflict. Two other factors leading to increased differences in individual goals and thus to increased intragroup conflict are small expectation of realizing the group's goal, and low degree of member identification with the group. Intragroup conflict reduces the group's control over its environment and the uniformity of group opinion. And a reduction in these two factors tends to reduce the amount of pressure the group can exercise over its members to support the organization's goal. There must be some pressure over members to encourage behavior that is con-

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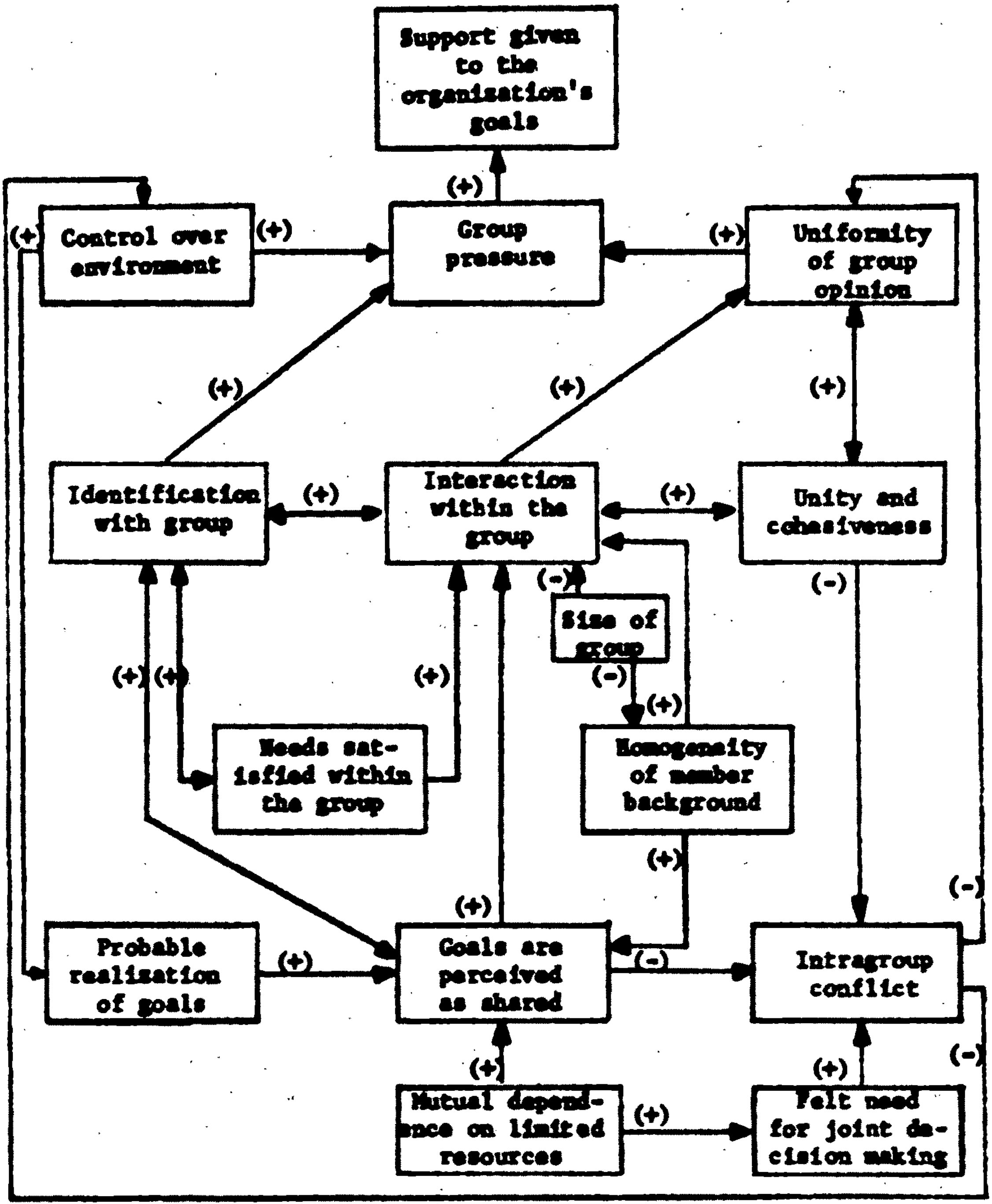
Support given to the organization's goals
(+)
Control over environment
(+)
Group pressure
(+)
Uniformity of group opinion
(+)
(+)
(+)
(+)
Identification with group
(+)
Interaction within the group
(+)
Unity and cohesiveness
(-)
Size of group
(-)
(+)
(+)
(+)
(+)
Needs satisfied within the group
Homogeneity of member background
(+)
(+)
(-)
Probable realization of goals
(+)
Goals are perceived as shared
(-)
Intragroup conflict
(-)
(+)
(+)
Mutual dependence on limited resources
(+)
Felt need for joint decision making

Figure 1. Factors affecting members' decision to support the organization's goals

sistent with group goals and to discourage behavior that is inconsistent with group goals. This pressure may originate from internal and external sources. The strength of group pressures over members is a positive function of the group's control over the environment, member identification with the group, and uniformity of group opinion.

Empirical work suggests that the more unity and cohesiveness among members and the more frequent is interaction or communication within the group, the more uniform will be group opinion. (Interaction is not to be confused with intragroup conflict. The former is essential to organizational progress and survival. The latter stifles organizational progress and threatens organizational survival.) Further, the more cohesive the group, the more willing are its members to enforce group demands on the individual, thus restricting intragroup conflict, which would otherwise weaken the group's control over the individual.

Frequency of interaction is postulated to be a positive function of several variables including the strength of cultural pressures to participate, number of individual needs satisfied in the group, extent to which goals are perceived as shared, group cohesiveness, and homogeneity of member background. Frequency of interaction is a negative function of the size of the group because interaction is more difficult in large than in small groups. Finally, in addition to inducing more uniformity of opinion, frequent interaction strengthens member identification with the group and tends to encourage unity and cohesiveness within the group.

Union Goals

Hallberg's synthesis does not deal with determination of group goals. Many of the elements that Hallberg relates to member support given to group goals also influence selection of group goals. This is clearly, though sometimes only implicitly, shown in Atherton's new book on labor union goals [1]. What might be termed "Atherton's simplest complete model" assumes all members have the same preference ordering and uses the following symbols:

w = money wage rate, \$/hour,
h = number of hours in the work week,
$j = 24(7) - h$ = weekly number of leisure hours,
t = withholding tax, \$/hour,
p = index of consumer prices,
e = number of workers employed,
S = strike length in days.

All of these variables affect the utility of a union and of its members. The first three are subject to bargaining; the last four are not. He uses a labor-demand function $e = e(w, h)$. And he introduces a strike-length function $S = S(w, h)$, that tells how long the union must strike to win a contract fixing the wage rate at w and the work week at h. Atherton's "Complete Utility Function" [1, p. 46] is

$$U = U[wh(1 - t)/p, j, e, S].$$

The expression $wh(1 - t)/p$ is weekly real disposable income per employed worker. His inclusion of member employment and of income of employed members follows previous practice; see Cartter [3], for example. His inclusion of leisure time and of strike length is, so far as I know, novel; and his reasons for doing so are convincing, at least to me.

The goals of an organization can be expected to reflect desires of the elected leaders as well as desires of the members. Atherton extends his simplest complete model to incorporate some of the ideas of Berkowitz [2] by assuming that union leadership desires to retain the right to act as the workers' bargaining agent and, once that is assured, desires to maximize the union's net revenue.

He concludes that the wage rate that maximizes the union's net revenue is often lower and is never higher than the membership's optimum wage rate [1, pp. 76, 85]. In relaxing the assumption that members have the same preference ordering and allowing heterogeneity of member preferences (but still assuming the same wage rate for all employed members), Atherton uses the concepts of "membership optimum" and "majority wage." At a membership optimum, no one feels he can better his position. The majority wage is a wage such that no other single wage rate would be considered superior to it by a majority of the union's members [1, p. 81]. He discusses union efforts to retain membership in the face of divergence of preferences among members [1, pp. 87–99]. Finally, he introduces uncertainty into his analysis [1, Chps. VI and VII].

It was only recently that I saw this book for the first time, and I have not had time to study it thoroughly. But it seems to me to offer a good deal of insight into union behavior. As Atherton points out [1, p. 5], his book does not deal with bargaining theory. His book does provide one of the building blocks of bargaining theory, however, because a bargaining theory must build on knowledge of participants' preferences. The model in the next section incorporates some, but not all, of the ideas presented by Atherton.

The Titular Model[1]

This section presents the model referred to in the title. The August issue of the *American Journal of Agricultural Economics* contains my paper on "A Model of a Bargaining Cooperative" [7]. My invitation to present a paper at our meetings asked me to apply the same procedure to the analysis of labor unions here that I applied to analysis of cooperatives in that paper. Applying that procedure to unions requires knowing something of union objectives. Cartter [3] has written, ". . . historically, unions have been primarily interested first in recognition, second in various security measures insuring survival, and finally in material benefits for its members." My impression of labor economics (admittedly gathered from a small sample of the literature) is that economists have concentrated almost exclusively on the last named aim: material benefits for members. Certainly material benefits are easier to define and measure than are "recognition" and "survival."

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[1] This section of the paper has benefited from comments by Robert D. Emerson and J. Peter Mattila on an earlier version.

This paper will follow the labor economics tradition and will concentrate on material benefits for members, but will not completely ignore recognition and survival. Material benefits include wages and such fringe benefits as pensions, and medical and hospital programs. They may also include such things as better working conditions in the form of improved transportation, drinking water, restroom facilities, and hot lunches. This paper will also follow labor economics tradition in combining wage rates and fringe benefits. Throughout this section of the paper, "wage rate" is to mean hourly wage rate paid the employee plus cost of fringe benefits, if any, per hour worked.

The first two objectives listed by Cartter—recognition and survival—require the union to pay some attention to size. To attract and hold members, unions find it advisable to perform various services for their members, in addition to bargaining over wage rates. The reasons are analogous to the reasons that farm bargaining cooperatives perform various services for their members in addition to bargaining over price of members' product. (For some discussion of this point, see Ladd [7].) One reason is that bargaining over wage rates (or farm product prices) is a "nonexcludable public good." One need not be a member of the union (or the cooperative) to benefit from these activities, because union wage rates affect non-union wage rates, but only members support this activity. The wage rate bargaining activity, therefore, attracts members, but its costs repel members. To overcome the repellent effect, unions provide additional services. Another reason, closely allied to the first, that organizations find it desirable to provide a variety of services to members, is that members are not all alike. Services that appeal to some will not appeal to others. Unions (and cooperatives) provide "excludable public goods," goods that benefit only members, in efforts to attract and hold members.

Variables and equations

In this paper the union is assumed to provide two services to members in addition to bargaining over wage rates. The first service is an excludable public good in the sense that it does not benefit non-members, although it may affect unionized firms' cost functions, and therefore unionized firms' demands for labor. (Unionized firms have signed contracts with the union, and employ only union members.) Examples of union activities that lower firms' cost functions might be operation of union hiring halls or of "full-supply contracts" that call for the union to provide all the workers the employer needs. Examples of activities that may raise employers' cost functions are bargaining over work rules or seniority provisions. Let Q_1 be the amount of this first service provided by the union.

The second excludable public good is financed entirely by the union; members are not charged directly for this service. Members finance the service, however, because union members provide union income, and this service is financed out of union income. Examples of such a service might be job placement, union picnics, meetings, or newsletters. Performance of this service does not affect the employers' cost functions. Let Q_4 be the amount of this service provided by the union.

It is assumed that only employed workers are union members. Determination of union size, therefore, requires consideration of level of employment. Level of employment will be derived by considering total supply of labor, employment by unionized employers, and employment by non-unionized employers. (A non-unionized employer has not signed a contract with the union. He employs union members and non-members.)

Union membership is derived from the employed labor force because only employed workers are members. Demand for labor by unionized employers, in effect, becomes a union membership function for unionized plants, because all employees of these employers are members. A union membership function for employees of non-unionized plants is derived from the labor demand function of non-unionized plants.

Let E_{mu} be the number of members employed by unionized firms and express the total demand for labor by unionized firms as

$$(1) \qquad E_{mu} = e_{mu}n_u$$

where n_u is the number of unionized firms in the industry and e_{mu} is the number of workers demanded by the average unionized firm. (The number of hours worked per employee is assumed to be the same for all employees—member and non-member. Labor supply, labor demand, and union membership, then, are all measured in terms of number of workers.) The average unionized firm's demand for labor can be expressed as

$$e_{mu} = e(W_u, Q_1, Q_2) \tag{2}$$

where Q_1 is the amount of the first service (the service that affects employers' cost function) provided by the union, Q_2 is the amount of the union's activity in bargaining over wage rates, and W_u is the wage rate paid by unionized firms. The bargaining activity shifts the employer's demand function to the right; therefore $\partial e_{mu}/\partial Q_2 > 0$. As mentioned earlier, the first service may raise or lower the employer's cost function. Therefore $\partial e_{mu}/\partial Q_1 \gtreqless 0$. And, of course, $\partial e_{mu}/\partial W_u < 0$. (Throughout the discussion of this model, a letter (capital or lower case) with subscripts identifies a variable; a letter without subscript identifies a function. Thus e_{mu} is a variable and e is the function determining the value of the variable e_{mu}.)The number of unionized firms is determined from

$$n_u = n(W_u, W_n, Q_1, Q_3). \tag{3}$$

W_n is the wage rate paid by all non-unionized firms, and Q_3 is the amount of the union's organizing activity. This latter is the union's activity in trying to induce non-members to become members and in trying to induce non-unionized firms to sign contracts with the union. It is assumed that $\partial n_u/\partial W_u < 0$, $\partial n_u/\partial W_n$ and $\partial n_u/\partial Q_3$ are positive, and $\partial n_u/\partial Q_1 \gtreqless 0$.

Let E_{tn} be the total number of workers employed in non-unionized firms and express the total demand for labor by these firms as

$$E_{tn} = e_{tn} n_n \tag{4}$$

where n_n is the total number of non-unionized firms in the industry and e_{tn} is labor demand by a typical non-unionized firm.

Suppose e_{tn} and n_n are determined from

$$e_{tn} = e'(W_n) \tag{5}$$

$$n_n = n'(W_u, W_n, Q_1, Q_3). \tag{6}$$

It is assumed that $\partial e_{tn}/\partial W_n$, $\partial n_n/\partial W_n$, and $\partial n_n/\partial Q_3$ are negative; $\partial n_n/\partial W_u > 0$, and $\partial n_n/\partial Q_1 \gtreqless 0$.

This model does not explicitly account for seasonal variation in demand for labor by agricultural firms. Firms with substantial seasonal variability in their need for labor typically bargain over a schedule of labor during the contract period.

Non-unionized firms do not distinguish between member and non-member employees. Of the total number of workers demanded by these firms, a proportion, P_m, are (or become) union members. The number of union members working for non-union firms, E_{mn}, is

$$E_{mn} = P_m E_{tn}, \tag{7}$$

and P_m is determined from

$$P_m = P(Q_1, Q_2, Q_3, Q_4, W_{mn}/W_n). \tag{8}$$

Q_4 is the amount of the excludable public good provided in efforts to attract and maintain membership. W_{mn} is the "net" wage rate received by members employed by non-unionized firms. The difference between W_{mn} and W_n is the dues paid to the union. The partial derivative of P_m with respect to each variable in the function P is assumed positive.

Now, total number of union members, E_m, can be written as

$$E_m = E_{mu} + E_{mn}. \tag{9}$$

The wage rates to be used in deriving labor supply and union objectives are "net" wage rates. For members, these differ from W_u and W_n by union dues. It will be assumed that union dues exactly equal the union's total cost of operation. Let $C(Q_1, Q_2, Q_3, Q_4)$ be the union's total cost of operation; it depends upon the levels of the four services performed. Then $C(Q_1, Q_2, Q_3, Q_4)/E_m$ is the amount of each member's dues, and "net" wage rates for members employed by union and non-union firms are

$$W_{mu} = W_u - C(Q_1, Q_2, Q_3, Q_4)/E_m \tag{10}$$

$$W_{mn} = W_n - C(Q_1, Q_2, Q_3, Q_4)/E_m. \tag{11}$$

The labor supply to the industry is assumed to be determined by the expected net wage rate. The expected net wage rate is $(E_{mu}W_{mu} + E_{mn}W_{mn} + (E_{tn} - E_{mn})W_n)/(E_{mu} + E_{tn})$. If the union operates a union hiring hall or has a full-supply contract, it may recruit workers. This will tend to increase supply of labor to the industry. Letting S_t be total supply of labor to the industry, the labor supply curve is

$$S_t = S[(E_{mu}W_{mu} + E_{mn}W_{mn} + (E_{tn} - E_{mn})W_n)/(E_{mu} + E_{tn}), Q_1, W_0]. \tag{12}$$

W_0 is wage rate paid by other industries that compete for workers with the industry being analyzed in this model. Its value is assumed to be determined independently of the actions of this industry and this union.

The industry's labor market is assumed to be in equilibrium. Hence

$$S_t = E_{mu} + E_{tn}. \tag{13}$$

The industry is not completely unionized: $E_{tn} > 0$. The total number of workers available to unionized firms at the existing unionized wage rate, therefore, exceeds the demand by these firms. Some workers willing to work at wage rate W_u, but unable to find jobs at this wage rate, will offer their labor to non-unionized firms, thereby reducing W_n. Non-union and union wage rates are related by

$$W_n = V(W_{mu}, E_{mu}/E_{tn}, Q_3). \tag{14}$$

The ratio E_m/E_{tn} is a measure of "union coverage"; it measures the proportion of total industry employment that is employed in unionized firms. Equation (14) is much like the formulation that Rosen uses in his analysis of the relation between union and non-union wage rates [9]. But he excludes Q_3 and expects $\partial W/\partial(E_{mu}/E_{tn}) > 0$ at low levels of union coverage and expects $\partial W/\partial(E_{mu}/E_{tn}) < 0$ at high levels of union coverage. The union I am dealing with is in a lowly unionized industry, and I assume $\partial W/\partial(E_{mu}/E_{tn}) > 0$. $\partial W_n/\partial W_{mu}$ and $\partial W_n/\partial Q_3$ are assumed positive. As union wage rates rise or as the union increases its organizational efforts (increases Q_3), non-unionized firms attempt to offset this by increasing W_n.

To allow for all three of Cartter's objectives (union recognition, union survival, and members' material benefits) we can assume that the union acts to maximize the union's utility U_u, where

$$U_u = U(W_{mu}, W_{mn}, E_{mu}, E_{mn}). \tag{15}$$

Its instruments for attaining this objective are Q_1, Q_2, Q_3, and Q_4: the union selects the levels of these four services to maximize U_u. E_{mu} and E_{mn} contribute to recognition and survival; W_{mu} and W_{mn} contribute to member benefits.

Equations (1) through (15) are a system of 15 equations in the 15 dependent variables S_t, W_u, W_n, E_{mu}, e_{mu}, n_u, E_{tn}, e_{tn}, n_n, P_m, E_{mn}, E_m, W_{mu}, W_{mn}, and U_u. The results we would obtain by using (1) through (15) to determine the four first-order equilibrium conditions $\partial U_u/\partial Q_i$ for $i = 1, 2, 3, 4$ are too complex to provide any intuitive insight into union behavior. (It will be seen that the results from a much simpler model are still quite complicated.) Before beginning the analysis, I will derive a simpler model. I did want to present the preceding model so that we could see what I was assuming away in the simpler model.

The first step in simplification will be to assume that $P_m = 0$: non-unionized firms employ only non-union members. Then $E_{mn} = 0$. This eliminates equations (7) and (8). Eliminating (8) eliminates the variable Q_4. Now $E_m = E_{mu}$, and variable E_{mu} and equation (9) can be eliminated. Also, equation (11) and variable W_{mn} can be eliminated.

Assume total employment in the industry, E_t, is fixed, and derive E_{tn} from

$$E_{tn} = E_t - E_m \tag{4.1}$$

Use of equation (4.1) replaces (4), (5), and (6), and eliminates e_{tn} and n_n. Equation (12) can now be rewritten as

$$S_t = S[(E_m W_{mu} + E_{tn}W_n)/E_t, W_0, Q_1]. \tag{12.1}$$

Next, substitute (2) and (3) into (1) to obtain

$$E_m = E(W_u, W_n, Q_1, Q_2, Q_3). \tag{1.1}$$

This equation replaces equations (1), (2), and (3), and eliminates variables e_{mu} and n_u. It is perhaps more natural to think of the effect of bargaining on wage rates than of the effect on employment. Solve (1.1) for W_u to obtain

$$W_u = W(E_m, W_n, Q_1, Q_2, Q_3). \tag{1.2}$$

Equation (4.1) and variable E_{tn} can be eliminated by substituting (4.1) into (12.1), (13), and (14) yielding

$$S_t = S[(E_m W_{mu} + (E_t - E_m)W_n)/E_t, W_0, Q_1] \tag{12.2}$$

$$S_t = E_t \tag{13.1}$$

$$W_n = V(W_{mu}, E_m/(E_t - E_m), Q_3). \tag{14.1}$$

Now, substitute (1.2) into (10) to eliminate W_u.

$$W_{mu} = W(E_m, W_n, Q_1, Q_2, Q_3) - C(Q_1, Q_2, Q_3)/E_m \tag{10.1}$$

Substitute (12.2) into (13.1) to eliminate S_t.

$$S[(E_m W_{mu} + (E_t - E_m)W_n)/E_t, W_0, Q_1) = E_t \tag{13.2}$$

Finally, suppose the union's goal is simply to maximize W_{mu}. This eliminates (15). We are left with a system of three equations—(10.1), (13.2), and (14)—in three dependent variables—E_m, W_{mu}, and W_n. This is the system to be analyzed.

For convenience, these three equations are collected together here and rewritten as

$$(16.1)\quad F_1 = S[(E_m W_{mu} + (E_t - E_m)W_n)/E_t, W_0, Q_1] - E_t = 0$$

$$(16.2)\quad F_2 = W_n - V(W_{mu}, E_m/(E_t - E_m), Q_3) = 0$$

$$(16.3)\quad F_3 = W_{mu} - W(E_m, W_n, Q_1, Q_2, Q_3) + C(Q_1, Q_2, Q_3)/E_m = 0$$

Also, the assumptions about the signs of the functions are collected here.

$$(17.1)\quad \partial S/W_{mu} > 0,\ \partial S/\partial W_n > 0,\ \partial S/\partial Q_1 > 0,\ \partial S/\partial W_0 < 0$$

The S function can be rewritten as

$$S[W_n + E_m (W_{mu} - W_n)/E_t, W_0, Q_1].$$

Whether the expected wage rate rises or falls as E_m rises depends upon the sign of $(W_{mu} - W_n)$. Therefore $\partial S/\partial E_m \gtreqless 0$.

$$(17.2)\quad \partial V/\partial W_{mu} > 0,\ \partial V/\partial E_m > 0,\ \partial V/\partial Q_3 > 0,\ \partial V/\partial E_t < 0$$

$$(17.3)\quad \partial W/\partial E_m < 0,\ \partial W/\partial W_n > 0,\ \partial W/\partial Q_2 > 0,\ \partial W/\partial Q_3 > 0$$

The previous discussion of $\partial e_{mu}/\partial Q_1$ and $\partial_{nu}/\partial Q_1$ implies that $\partial W/\partial Q_1 \gtreqless 0$. Throughout the rest of the analysis, it will be assumed that $\partial W/\partial Q_1 > 0$. $\partial(C/E_m)/\partial E_m = -C/E_m^2 < 0$. This last partial derivative is the change in the per-member cost of the union as membership rises.

Maximization of net wage rate

The system (16.1) to (16.3) is not linear in the dependent variables. Equation (16.1) contains E_m in the numerator, and (16.2) and (16.3) contain E_m in the denominator. This nonlinear system can be "linearized" by taking total differentials of each equation; the resulting system is linear in the differentials. From these differential equations, the partial derivatives $\partial W_{mu}/\partial Q_1$, $\partial W_{mu}/\partial Q_2$, and $\partial W_{mu}/\partial Q_3$ can be determined. Equating these partial derivatives to zero yields the first-order equilibrium conditions for determining the values of Q_1, Q_2, and Q_3 to maximize W_{mu}.

The total differential of equation (16.i) can be written as

$$(17)\quad dF_i = dE_m\partial F_i/\partial E_m + dW_{mu}\partial F_i/\partial W_{mu} + dW_n\partial F_i/\partial W_n + dQ_1\partial F_i/\partial Q_1 + dQ_2\partial F_i/\partial Q_2 + dQ_3\partial F_i/\partial Q_3 + dW_0\partial F_i/\partial W_0 + dE_t\partial F_i/\partial E_t.$$

If we apply (17) in turn to (16.1), (16.2), and (16.3), the results can be expressed in vector-matrix notation as

$$(18)\quad JdY = K_1dQ_1 + K_2dQ_2 + K_3dQ_3 + K_4dW_0 + K_5dE_t$$

where

$$J = \begin{pmatrix} \partial S/\partial E_m & \partial S/\partial W_{mu} & \partial S/\partial W_n \\ -\partial V/\partial E_m & -\partial V/\partial W_{mu} & 1 \\ \partial(C/E_m)/\partial E_m - \partial W/\partial E_m & 1 & -\partial W/\partial W_n \end{pmatrix}$$

$$dY = (dE_m \quad dW_{mu} \quad dW_n)'$$

$$K_1 = \begin{pmatrix} -\partial S/\partial Q_1 \\ 0 \\ \partial W/\partial Q_1 - E_m^{-1}\partial C/\partial Q_1 \end{pmatrix},$$

$$K_2 = \begin{pmatrix} 0 \\ 0 \\ \partial W/\partial Q_2 - E_m^{-1}\partial C/\partial Q_2 \end{pmatrix},$$

$$K_3 = \begin{pmatrix} 0 \\ \partial V/\partial Q_3 \\ \partial W/\partial Q_3 - E_m^{-1}\partial C/\partial Q_3 \end{pmatrix},$$

$$K_4 = \begin{pmatrix} -\partial S/\partial W_0 \\ 0 \\ 0 \end{pmatrix}, \quad K_5 = \begin{pmatrix} 1 - \partial S/\partial E_t \\ \partial V/\partial E_t \\ 0 \end{pmatrix}$$

To evaluate $\partial W_{mu}/\partial Q_i$, proceed as follows. Set $dQ_j = 0$ for $j \neq i$ and set $dW_0 = dE_t = 0$. Divide both sides of (18) by dQ_i. The result is

$$J \begin{pmatrix} \partial E_m/\partial Q_i \\ \partial W_{mu}/\partial Q_i \\ \partial W_n/\partial Q_i \end{pmatrix} = K_i$$

Solving for $\partial W_{mu}/\partial Q_i$ by Cramer's rule yields

$$(19) \qquad \partial W_{mu}/\partial Q_i = \operatorname{Det} J_{Wi}/\operatorname{Det} J$$

where J_{Wi} is obtained from J by replacing the second column of J by K_i. Assume that Det $J \neq 0$. Then a necessary and sufficient condition for $\partial W_{mu}/\partial Q_i = 0$, that is, for the first-order maximization condition to be satisfied, is that Det $J_{Wi} = 0$. Thus,

$$\operatorname{Det} J_{W1} = \operatorname{Det}\begin{pmatrix} \partial S/\partial E_m & -\partial S/\partial Q_1 & \partial S/\partial W_n \\ -\partial V/\partial E_m & 0 & 1 \\ \partial(C/E_m)/\partial E_m - \partial W/\partial E_m & \partial W/\partial Q_1 - E_m{}^{-1}\partial C/\partial Q_1 & -\partial W/\partial W_n \end{pmatrix}$$
$$= (E_m{}^{-1}\partial C/\partial Q_1 - \partial W/\partial Q_1)(\partial S/\partial W_n \partial V/\partial E_m + \partial S/\partial E_m) + \partial S/\partial Q_1(\partial W/\partial E_m - \partial(C/E_m)/\partial E_m - \partial V/\partial E_m \partial W/\partial W_n)$$

Equating to zero and solving for $\partial C/\partial Q_1$ yields (19) as the first-order condition for maximization of W_{mu} with respect to Q_1.

$$(20) \qquad \partial C/\partial Q_1 = E_m \partial W/\partial Q_1 + E_m \partial S/\partial Q_1 [\partial(C/E_m)/\partial E_m - \partial W/\partial E_m - \partial W/\partial W_n \partial V/\partial E_m]/A_W$$

where

$$A_W = \partial S/\partial E_m + \partial S/\partial W_n \partial V/\partial E_m.$$

Because $E_m > 0$, it is easily seen that $\partial C/\partial Q_1$ is larger if $\partial W/\partial Q_1$ is large than if $\partial W/\partial Q_1$ is small. The term in brackets on the right-hand side of (20) may be positive, negative, or zero. And A_W may be positive or negative. Thus it is not possible to determine whether an increase in $\partial S/\partial Q_1$ serves to increase or decrease the equilibrium level of $\partial C/\partial Q_1$. If $W_{mu} - W_n > 0$, then $\partial S/\partial E_m > 0$ (see discussion under (17.1)), and A_W can be positive even though $\partial S/\partial E_m < 0$. Assume $A_W > 0$. Then it can be determined that increases in $\partial W/\partial W_n$ and $\partial W/\partial E_m$ decrease the equilibrium level of $\partial C/\partial Q_1$, and that increases in $\partial(C/E_m)/\partial E_m$ increase the equilibrium level in $\partial(C/E_m)/\partial E_m$ increase the equilibrium level of $\partial C/\partial Q_1$. Assume a J-shaped marginal cost curve for service one and assume $A_W > 0$. Then anything that increases the equilibrium value of $\partial C/\partial Q_1$ also increases the equilibrium level of the first service. Thus, the equilibrium level of the first service tends to be high if: (a) unionized firms' wage rate is sensitive to this service ($\partial W/\partial Q_1$ is high), (b) per-member cost of union operation is insensitive to changes in size of union ($\partial(C/E_m)/\partial E_m$ approaches zero from below), (c) unionized firms' wage rate is insensitive to non-union wage rates ($\partial W/\partial W_n$ is low), or (d) if wage paid by unionized firms is insensitive to number of workers demanded ($\partial W/\partial E_m$ approaches zero from below).

Additional insight can be gained by manipulating the right-hand side of (20) and introducing some new notation. Consider the last term in the brackets. As E_m varies, it influences non-union wage rate W_n through the function V. As non-union wage rate varies, it influences union wage rate through the function W. Write this product of two partial derivatives as $\partial W_u(W, V)/\partial E_m$. This measures the indirect impact of a one-unit variation in E_m on W_u: the impact coming through the W and V functions. Now write $\partial W/\partial E_m$ as $\partial W_u(W)/\partial E_m$. This measures the direct impact of unit variation in E_m on W_{mu} through the W function. Now write $\partial W_u(W)/\partial E_m + \partial W_u(W, V)/\partial E_m$ as $\partial W_u(W + W, V)/\partial E_m$. This measures total direct and indirect impact of variation in E_m on W_u. The first two terms in the brackets are $-\partial W_{mu}/\partial E_m$. Thus, the entire term in brackets can be written as $-\partial W_{mu}/\partial E_m - \partial W_u(W + W, V)/\partial E_m$. Following similar reasoning, A_W can be expressed as $\partial S_t(S + S, V)/\partial E_m$. $\partial S/\partial E_m$ measures direct impact of unit variation in E_m on labor supply. $\partial S/\partial W_n \partial V/\partial E_m$ measures indirect impact of unit variation in E_m on S_t; variation in E_m affects W_n through the V function, and the variation in W_n affects S_t through the S function. Thus A_W equals the total direct and indirect impact of unit variation in E_m on S_t. Now (20) can be written as

$$(21) \qquad \partial C/\partial Q_1 = E_m \partial W/\partial Q_1 - E_m \partial S/\partial Q_1 DW/DS$$

where

$$DW = \partial W_{mu}/\partial E_m + \partial W_u(W + W, V)/\partial E_m$$
$$DS = \partial S_t(S + S, V)/\partial E_m$$

The first term on the right-hand side of (20) represents the marginal contribution of service one to increasing the total wage expenditure of union firms ($W_u E_m$) with a given level of employment. In the second term, the marginal effect of service one on labor supply is multiplied by union employment and by the sum of the effect of E_m on W_{mu} and the effect of E_m on W_u; this is divided by the total impact of E_m on S_t.

To evaluate $\partial W_{mu}/\partial Q_2 = 0$, set $i = 2$ in (19), and set Det $J_{W2} = 0$. If $A_w \neq 0$, simple manipulation yields as the first-order equilibrium condition

$$\partial C/\partial Q_2 = E_m \partial W/\partial Q_2. \tag{22}$$

In equilibrium, the union's marginal cost of the second service (bargaining over wage rate) equals the marginal effect of bargaining on the employers' total wage bills for union labor (with a fixed level of employment). If $\partial W/\partial Q_2$ is (at least in the minds of union leaders) high when employers' profits are high, times of high profits will be times of high levels of Q_2 (assuming a J-shaped marginal cost curve for Q_2). Equation (22) is simpler than equation (20) because Q_2 does not enter the labor supply function, whereas Q_1 does.

Setting $i = 3$ in (19) and solving Det $J_{W3} = 0$ for $\partial C/\partial Q_3$ yields (23) as the first-order condition for Q_3.

$$\partial C/\partial Q_3 = E_m \partial W/\partial Q_3 + E_m \partial V/\partial Q_3 B_W/A_W \tag{23}$$

where

$$B_W = \partial S/\partial E_m \partial W/\partial W_n + \partial S/\partial W_n[(\partial C/E_m)/\partial E_m - \partial W/\partial E_m].$$

A_W may be positive or negative, and B_W may be positive, negative, or zero. It is not possible, therefore, to determine *a priori* the effect on $\partial C/\partial Q_3$ of increasing $\partial V/\partial Q_3$. An increase in $\partial V/\partial Q_3$ means that the union's organizing activities are having an increasing impact on non-union wage rates. If we assume a J-shaped marginal cost curve for organizational activity and assume $A_W > 0$, it follows that: (a) increases in $\partial S/\partial E_m$ or $\partial(C/E_m)/\partial E_m$ increase the equilibrium level of service three and that (b) increases in $\partial W/\partial E_m$ decrease the equilibrium level of the third service. This latter expression, for example, means that as the wage rate paid by union firms becomes less sensitive to level of employment ($\partial W/\partial E_m$ approaches zero from below), the union's equilibrium level of organizational activity increases.

If the marginal cost curve for organizational activity is J-shaped, then, as the wage rate paid by union firms becomes more sensitive to this activity ($\partial W/\partial Q_3$ rises), the equilibrium level of this activity rises.

Maximization of union membership

The first-order equilibrium conditions for maximization of E_m are presented, without discussion, here. The first-order equilibrium condition for Q_1 can be expressed as

$$\partial C/\partial Q_1 = E_m \partial W/\partial Q_1 + E_m[\partial S/\partial Q_1 (1 - \partial W_n(W, V)/\partial W_{mu})]/\partial S_t(S + S, V)/\partial W_{mu} \tag{24}$$

where

$$\partial W_n(W, V)/\partial W_{mu} = \partial W/\partial W_n \partial V/\partial W_{mu}$$

$$\partial S_t(S + S, V)/\partial W_{mu} = \partial S/\partial W_{mu} + \partial S/\partial W_n \partial V/\partial W_{mu}$$

If $\partial S/\partial W_{mu} + \partial S/\partial W_n \partial V/\partial W_{mu} \neq 0$, the first-order condition for Q_2 is

$$\partial C/\partial Q_2 = E_m \partial W/\partial Q_2. \tag{25}$$

The first-order equilibrium condition for Q_3 can be expressed as

$$\partial C/\partial Q_3 = E_m \partial W/\partial Q_3 + E_m[\partial S_t(S + S, W)/\partial W_n]/\partial S_t(S + S, V)/\partial W_{mu} \tag{26}$$

where

$$\partial S_t(S + S, W)/\partial W_n = \partial S/\partial W_n + \partial S/\partial W_{mu} \partial W/\partial W_n.$$

By adding a fourth equation—(16.4)—to the system (16.1) to (16.3), we could determine first-order conditions for a union wishing to maximize some combination of W_{mu} and E_m.

$$F_4 = U_u - U(W_{mu}, E_m) = 0 \tag{16.4}$$

Cartter [3] uses indifference curves to analyze behavior of a union having W_{mu} and E_m in its objective function.

Relation between Union and Non-Union Wage Rates

Both my models allow union and non-union wage rates to influence each other. Rosen [9] has analyzed the relation between the two wage rates. If p is the probability of unionization of a non-union firm, the expected wage rate confronting a non-union firm is $E(W) = (1 - p)W_n + pW_u$. Rosen determines W_n to minimize $E(W)$.

His resulting relation can be written as $W_n = G(W_u, U)$ where U is the proportion of the industry that is unionized. G is a monotonically increasing function of W_u; but W_n is assumed to rise as U rises from low to high values and then to decline as U rises still further. The union's relation between the three variables is expressed as $W_u = F(W_n, U)$, a monotonically increasing function of both W_n and U. The value of U is assumed to be determined independently of W_n and W_u. For given value of U, the values of W_n and W_u are determined by the point of intersection of the functions F and G. As U rises from low to high levels, both W_n and W_u rise. But Rosen expects further increases in U to reduce W_n while W_u continues to rise.

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Work Behavior of Low-Income, Rural Nonfarm Wage Earners

D. LEE BAWDEN

OF THE THREE major census subpopulations —farm, rural nonfarm, and urban—we know the least about the work behavior of the rural nonfarm population. Agricultural economists have directed most of their attention to farmers and, to a lesser extent, farm laborers, while general labor economists have been preoccupied with the urban sector. Work behavior of the rural nonfarm residents, which comprise 22 percent of the total U. S. population, has generally fallen between the slats.

The purpose of this paper is to take a modest step toward filling this gap by looking at the work behavior of one segment of the rural nonfarm population, namely low-income families in which both the husband and wife are present and the husband is of working age.

Data are from the Rural Negative Income Tax Experiment, which is a sample of 810 farm and rural nonfarm families in North Carolina and Iowa. The two samples were chosen to be representative of their respective regions and therefore should provide some insight into the work behavior of a broader spectrum of the rural south and midwest.

The principal purpose of the Rural Experiment was to measure the consequences of extending welfare payments to the working poor, those with incomes less than one and one half the poverty line at the beginning of the experiment. Approximately half of the sample received income-conditioned payments over a three-year period, the other half served as a control group. In order not to confuse "normal" work behavior, which is the subject of this paper, with behavior under a negative income tax, only the control group is used for the present analysis.[1] The population is further restricted to families in which (1) the head's principal source of earned income, if any, is from wages and salaries, (2) both husband and wife are present, and (3) the husband was able-bodied and less than age 60 at the beginning of the three-year period.[2] These restrictions reduce the sample size to 146 families.

Each family member over age 16 was interviewed quarterly over the three-year period, 1970–72, and information on work behavior was asked for the previous three months. Thus the interviews provide a rich and continuous source of data for the purposes of this paper.

Since so little is known about the work behavior of low-income rural nonfarm families, the first part of the paper will use descriptive statistics to provide demographic and economic profiles. Where appropriate, distinctions will be made along both regional and racial lines by considering three subgroups—Iowa, North Carolina blacks, and North Carolina whites.[3]

Following the descriptive profiles, the dynamics of family income will be addressed. Last, regression analysis will be used to relate certain family and regional characteristics to the wage income of husbands.

Descriptive Profiles

Socio-demographic

The mean age of the head of this sample is 42, which is about the average for the entire population in the age range of 20 to 60, from which this sample was selected. On average, wives are almost four years younger than their husbands.

The average educational attainment of both husbands and wives in Iowa is 10½ years, but only seven years for North Carolina husbands and eight and one half for North Carolina wives. There is virtually no difference in education levels between the two races in North Carolina.

The average number of children under 21 and still at home is four in Iowa, 3.2 for North Carolina blacks, and lowest of all—2.3—for North Carolina whites. However, the North Carolina families have more other adults living with the

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[1] The impact of the transfer payments on work behavior will be reported during the coming year in a series of publications of the Institute for Research on Poverty.

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[2] The sample, therefore, is not strictly defined as rural nonfarm by residence. It is, rather, defined by income source (wages and salaries) and therefore includes a few farm hands who live on their employer's farm, as well as some families who live in the open country and have small amounts of farm income (and therefore, might be defined as farmers by the Census Bureau) but work principally for wages.

[3] The Iowa sample was all white.

central family—an average of 0.4 and 0.2 for blacks and whites, respectively, compared to only 0.05 for Iowa families.

The distribution of occupations of husbands is only available by region. Nearly 40 percent of the Iowa wage earners were in the craftsman-kindred category. A fourth of these were auto mechanics. The remainder were distributed among carpentry, plumbing, painting, radio and TV repair, and machine operation. About 20 percent of the North Carolina sample were in the craftsman-kindred category, with almost half being carpenters and auto mechanics.

A fourth of the Iowa husbands were classified as operatives, with half of these being truck drivers. Forty percent of North Carolina husbands were operatives, a fourth of which were truck drivers.

Approximately 10 percent of the North Carolina sample, and virtually none of the Iowa sample, were service workers—janitors, barbers, hospital attendants, and kitchen workers. Eighteen percent of Iowa men were farm hands, while only 6 percent of North Carolina wage earners were in this occupational grouping.

Laborers represented nearly 10 percent of Iowa men and about 20 percent of the North Carolina sample.

There was a preacher, a sheriff, and a policeman, but the main bulk of the sample was in unskilled or semi-skilled occupations. The average wage rate was only $2.05 per hour. One in four husbands earned less than $1.60 per hour, while less than 10 percent earned more than $3.00 per hour.

Income

Turning now to an income profile of this sample, we begin by describing sources of income and contributions to family wage income by various family members, and wind up with data on some measures of work behavior.

Average family income of this sample over the three-year period 1970–1972 was $6145 per year. This is about three fifths of the average income of all male-headed rural nonfarm families. In terms of the poverty level ratio, this is about 1.5 the poverty line adjusted for family size.[4] In terms of a distribution, 24 percent were below the poverty line, 32 percent were between 1.0 and 1.5, 24 percent between 1.5 and 2.0, and 20 percent were over twice the poverty line.

Of the average total family income of $6145, over 93 percent was earned income, mostly from wages and salaries (hereafter simply referred to as wages). About 10 percent of the sample had some farm income, and approximately 5 percent had some business income, but those amounts were small, representing only 2 percent and less than 1 percent of total income, respectively. The Iowa subsample had the most farm and business income, but even here the two sources together represented only 6 percent of total family income.

About 6½ percent of total income, then, was unearned, with half of the families reporting such income. This represents a variety of kinds of income: unemployment insurance, food stamps, college scholarships, asset income, free meals at school, and life insurance benefits. The largest source under this category was the bonus value of food stamps, representing $125 per year or 2 percent of total income. A fifth of the families reported receiving such income; for them the net addition to income was about $600 per year.

Perhaps surprisingly, the next largest source was the value of free or subsidized meals received by children at school. Half the families reported receiving these benefits, and the net addition to their income was about $150 per year. None of the other sources of unearned income represented as much as six tenths of 1 percent of total income. At any given time less than 5 percent of the families received unemployment compensation, and less than 2 percent had any asset income.

Wages, then, represented over 90 percent of total family income, and over 98 percent of the families had wage income during any given quarter. Most of this wage income, about three fourths, was contributed by the husband; however, there was considerable variation by region and race. The relative contributions by husband, wife, and dependents at home under 21 years of age are shown below for the three subpopulations:

	Iowa	NC-W	NC-B
	Percent of Total		
husband	91	82	70
wife	7	13	26
dependents	2	5	4
Total	100	100	100

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[4] At first glance it may seem puzzling that the average poverty ratio could be 1.5 for a sample initially chosen to be below 1.5 the poverty line. However, the initial selection was based on 1968 and 1969 income, whereas the 1.5 average is for the period 1970–72.

The husband's contribution to all wage income of the family ranged from a low of 70 percent for North Carolina blacks to 91 percent for Iowans. However, the North Carolina black wives' share of family wage income (26 percent) was twice that of North Carolina white wives (13 percent), and over three and one half times that of Iowa wives (7 percent). The children's contribution to total family wage income was small, ranging from 2 percent in Iowa to 5 percent among North Carolina whites.

It is instructive to look now at the number of weeks worked, hours worked per week, and wage rates, the product of which determines wage income.

In any given quarter, over 96 percent of the husbands worked for wages, and 76 percent worked the entire 13 weeks of the quarter. Of those who worked at any time during the quarter, the average hours per week was slightly in excess of 40, and their wage rate averaged $2.05 per hour.[5]

It is informative to look at the regional and racial differences in these data. In any given quarter, about 5 percent of the black men in North Carolina were unemployed, 16 percent worked between 9 and 12 weeks, and 72 percent worked the entire 13 weeks. In contrast only 3 percent of Iowa men were unemployed, less than 6 percent worked 9–12 weeks, and 85 percent worked the entire 13 weeks. North Carolina white men fell approximately midway between these two extremes, suggesting differences in labor markets between the two regions as well as racial differences in North Carolina.

These differences, moreover, are magnified by the data on hours worked per week and wage rates per hour. A surprising 60 percent of the Iowa men worked over 45 hours per week, compared with 28 percent of white men in North Carolina and 20 percent of black men in North Carolina.[6] As to wage rates, 42 percent of Iowa men earned over $2.50 per hour, compared with 26 percent of whites in North Carolina and only 10 percent of North Carolina blacks. These differentials are also reflected in average wage rates (excluding the unemployed) of $2.37 for Iowa men, $2.14 for North Carolina whites, and only $1.89 for North Carolina black men.

So the black man faced more unemployment, less full time employment, and a lower wage rate than his white counterpart in North Carolina, despite the fact that he was of about the same age and had a slightly higher level of education. And the Iowa wage earner, of the same age but with three more years education, had less unemployment, more full time employment, more overtime work, and a higher wage rate.

The work experience of wives is somewhat the reverse situation from that of men with regard to racial and regional differences. Black wives, especially in low-income families, have traditionally had a greater attachment to the labor force, due in large part to the discrimination faced by their husbands and the resultant lower male earnings. Among the rural nonfarm families in this sample, we find 68 percent of black wives working in any given quarter, compared with 44 percent of North Carolina white wives and only 30 percent of Iowa wives. Moreover, twice as many black wives worked all 13 weeks in a quarter (35 percent) and three times as many worked 9 to 12 weeks (14 percent) compared to white wives. In terms of hours worked per week, a third of the black wives worked 25 or more hours versus 18 percent of North Carolina white wives and only 9 percent of Iowa wives.

These differences are not as pronounced for wage rates, however. Despite the fact that more black wives worked full time and, presumably, had a longer work history and more job tenure, their average wage rate was the same as for Iowa wives—$1.41 per hour. North Carolina white wives had a lower average wage rate—$1.27 per hour.

To summarize the economic profile briefly, we find this low-income rural nonfarm group to have a high attachment to the labor force. This industriousness is most exemplified by the black subsample, where 95 percent of the husbands and 68 percent of the wives worked in any given quarter. The men averaged 12 weeks per quarter and 41 hours per week. The working wives averaged almost 10 weeks per quarter and 31 hours per week.

The work experience of men in the other two subsamples is much the same—almost 97 percent worked, and they averaged 12 weeks per quarter and 43 hours per week. However, there are fewer wives working in these two groups: 44 percent of the North Carolina whites and 30 percent of the Iowa wives. They averaged 8 weeks per quarter and about 30 hours per week.

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[5] This $2.05 figure includes the average implicit wage rate of salaried workers. Twenty-two percent of the husbands were salaried, with a considerable racial differential. Only 12 percent of North Carolina black husbands were salaried, while 32 percent and 38 percent of North Carolina white and Iowa husbands, respectively, were salaried.

[6] Regional differences in hours per week may be slightly biased because a much higher proportion of Iowans were farm hands, who probably worked long hours in a week but who might also have tended to overestimate their actual hours of working time.

The inadequate incomes experienced by these families is obviously not because they cannot or will not work, nor is it principally due to sporadic or part-time employment. To be sure, the lack of a year-round, 40-hour-a-week job for some is a contributing factor to their low-income status, *but the principal problem is low wage rates*. With an average wage rate of $1.89 per hour, the black man can earn only $3931 if he works 40 hours per week, 52 weeks per year. And if he and his wife both work full time at the prevailing wage rates, together they cannot earn even $7000 per year.

The potential for North Carolina white families, who face no racial discrimination, is not much better, probably no more than an additional $500 to $1000 per year.[7]

The Dynamics of Family Income

Since the data base of the Rural Experiment is longitudinal in nature, with quarterly observations over a three-year period, it is of interest to look at the dynamics of family income: the proportion of families who move out of poverty or who fall into poverty, as well as the more general issue of magnitudes of income change over the three-year period.

Average family income rose from $5588 in 1970 to $6196 in 1971, an increase of $608, or almost 11 percent. From 1971 to 1972 the increase was $420 or a little over 8 percent. This average annual increase of 9.6 percent varied somewhat by subgroup, from 11.6 for North Carolina blacks to 9.9 for Iowans to 6.6 for North Carolina whites. During this period the poverty line, as adjusted by the Consumer Price Index, rose about 6 percent per year; thus the ratio of family income to the poverty level rose slightly, from 1.4 in 1970 to 1.6 in 1972. Not everyone experienced this modest increase in income, however. A third of the families had an income reversal from 1970 to 1972, while the other two thirds experienced income gains. In relation to the upward-inching poverty line, slightly over 40 percent of the families lost ground.

The situation looks slightly different in terms of movement into and out of poverty. Twenty-three percent of the families were below the poverty line in 1970. By 1972, half of these had moved out of the poverty classification. However, of the 77 percent above the poverty line in 1970, one in five had fallen *below* the line by 1972. Viewed as proportions of the total sample of families, 11 percent moved above the poverty line from 1970 to 1972, but nearly 16 percent dropped below the poverty line.[8]

Looking at all families, not just those crossing the poverty line, many of the income changes, both up and down, were substantial. In terms of poverty ratios, one in five families changed by more than three fourths the poverty index. For a family of four this represented a change in income of more than $2600. Measured on the same scale, another 11 percent of the families had income changes between $2600 and $1750, while less than 38 percent of the families had incomes which fluctuated less than $875.

These are substantial changes when viewed in terms of an average family income of about $6000. It illustrates the income instability which many low-income families must adjust to, a situation for which they are particularly ill-equipped, given their low net worth positions.[9]

These findings support those of other longitudinal studies (see, for example, [1] and [2]) which show that the poverty population is not a stable group. The incomes of low-income families can and do fluctuate substantially from month to month and year to year, and there are considerable differences in who is poor from one year to the next.

We turn next to regression analysis in an attempt to explore further the work behavior of low-income rural nonfarm families by relating husbands' wage income to various family, individual, and regional characteristics.

Regression Analysis

The type of analysis used here is error components, which allows the combining of cross-section and time series data in obtaining OLS regression estimates. The observations are quarterly, on 146 families over the three-year period. There are 1651 observations in all.[10]

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[7] This would be $500 if one uses the prevailing wage rates for white men and assumes their wives, who now work less than black wives, would have the same wage rate if they worked more; and $1000 if one assumes that white wives working full time would have wage rates 25 cents per hour higher than black wives, which is the current black/white wage differential for men.

[8] While this is slightly surprising, given the previous finding that the average ratio of income to the poverty line rose from 1.4 to 1.6 over the same period of time, it is not inconsistent. It merely means that the aggregate income increases exceeded in absolute magnitude the income decreases—and by more than the 6 percent annual rise in the poverty level.

[9] The average net worth of the sample families was only $1330.

The only regression equation presented here relates husbands' wage income per quarter to a number of hypothesized explanatory variables. For the sake of brevity, the rationale for selecting the independent variables will be omitted, and we proceed directly to the interpretation of the results, shown in Table 1.

The first two variables are (0, 1) dummies representing region (NC = 1) and race (black = 1). The coefficients are not directly interpretable because both variables also appear as interactions with age and education. Regional and racial differences in husband's earnings can be computed, however, by fixing age and education in these interaction variables at their sample means. Doing so we find that North Carolina white husbands average $340 less per year than Iowa husbands, controlling for all other factors in the regression equation. This compares with a sample mean difference of $1296, indicating that most of the latter difference is explained by other variables in the equation such as the higher level of education possessed by the Iowa husbands.

The racial difference in earnings is more pronounced. After controlling for all other factors, the regression shows that black husbands make $1380 per year less than white husband in North Carolina. This is larger than the sample mean difference of $764. The regression figure of $1380 might be regarded as an approximate measure of discrimination, with two important qualifications. First, the sample is only of low-income families, so this figure represents racial

Table 1. Husband's wage income, per quarter

Independent Variables				
No.	Name	Coefficient	t Statistic	Sig. Level
1.	Region Dummy (1 = NC)	1169.589	0.99	.32
2.	Race Dummy (1 = black)	1795.851	2.17	.03
3.	Head's Age	37.814	0.57	.57
4.	Head's Age Squared	—0.622	0.86	.39
5.	Head's Education	287.707	1.03	.30
6.	Head's Education Squared	—10.424	0.87	.38
7.	Head's Age × Education	—2.173	0.31	.76
8.	Head's Age Sq. × Education	0.051	0.65	.52
9.	Race × Age	—70.365	1.92	.06
10.	Race × Age Squared	0.777	1.78	.07
11.	Race × Education	—64.225	0.66	.51
12.	Race × Education Squared	—1.573	0.23	.82
13.	Region × Education	—305.103	1.20	.23
14.	Region × Education Squared	17.944	1.33	.18
15.	Other Adult Present (1 = yes)	11.442	0.37	.71
16.	Number of Dependents	19.213	1.64	.10
17.	Business Income (1 = yes)	168.201	2.63	<.01
18.	Acres Operated	—0.047	0.81	.42
19.	Acres Operated Squared	—0.003	0.02	.98
20.	Distance From Large Town	—7.950	3.40	<.01
21.	Unemployment Rate (%)	—30.586	2.09	.04
22.	Season 1—Winter	—51.578	3.27	<.01
23.	Season 2—Spring	20.151	1.45	.15
24.	Season 3—Summer	24.161	1.56	.12
25.	Quarter of Observation	27.777	2.92	<.01
26.	Quarter Squared	—0.581	0.81	.42
27.	Farm Hand (1 = yes)	—68.409	1.76	.08
28.	Other Family Income	0.004	0.18	.86
29.	Health Prevents Work (1 = yes)	—556.661	7.50	<.01
30.	In Job Training (1 = yes)	—1777.416	7.62	<.01
31.	Constant	—651.642	0.34	.73

$R = .590$ $\bar{R}^2 = .335$
$R^2 = .348$ $F = 13.84$

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[10] Twelve quarters times 146 families yields a maximum N of 1752. The loss of 101 quarterly observations is due to sample attrition via wage earners becoming farmers, separation of husband and wife, or simply refusing to be interviewed.

differences only among that group. As such, it probably is an under-estimate of the measure one would get for the entire rural nonfarm population. Secondly, the equation explains only 35 percent of the variance in wages earnings. One must therefore assume that the omitted variables are uncorrelated with race in order to regard this as an accurate measure of discrimination.

The next six variables (3–8) relate to age and education of the husband. Both age and education are represented in quadratic form, and age and age squared are each interacted with education. None of these variables are individually significant, but taken as a group they are significant at the .05 level. They cannot be interpreted, however, without reference to the next group of variables, 9–14. These are the interactions of race with age and age squared, and race and region with education and education squared. The interactions of race with age and age squared are both significant (.06 and .07, respectively). The two race and education interactions are not individually significant, but as a pair they are significant at the .03 level. The region and education interactions are not particularly significant, either individually (.23 and .18) or as a pair (.35).

The coefficients of these 12 variables plus those of the region and race dummies, when interpreted together, yield age/earnings profiles for the three subsamples. These profiles of husband's wage incomes are presented in Figure 1, holding education constant at eight years, approximately the sample mean. Since the equation has no regional interactions with age (they were tried in earlier runs but omitted in the final formulation because of their extremely low significance levels), the profiles for the two white subpopulations are the same except for a difference in level.

These profiles differ from the usual age/earnings relationships in that the sample is truncated with respect to income. We would therefore expect the curves to be flatter than for the entire U. S. population, and this is the case. The profiles of the two white low-income subsamples are flatter but in the same general shape as for the U. S. population as a whole—rising to about age 45 and then declining thereafter.

The age/earnings profile for the North Carolina black sample is just the reverse, with earnings decreasing at a decreasing rate until a minimum is reached at about 45 years of age, and then increasing again. The result is slightly surprising. I expected a fairly flat curve, or perhaps even one with a slightly downward slope, but not the U-shaped curve shown. An *ex post* rationale of such a profile is the following.

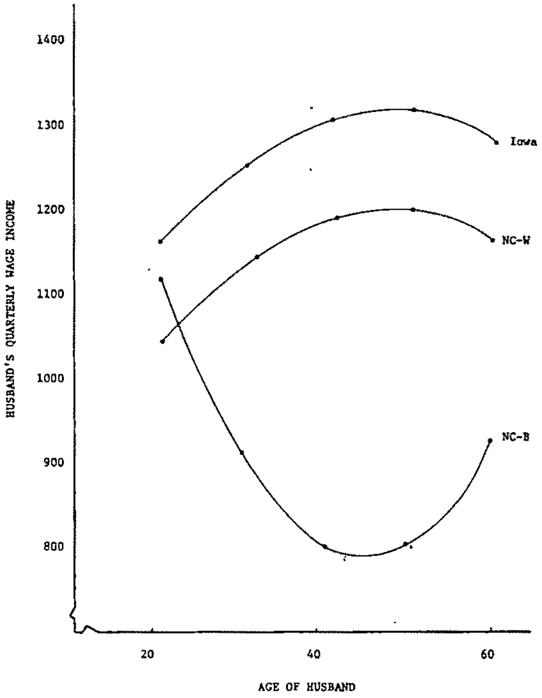

Figure 1. Age/earnings profiles

With integration of the public school system, previous research has shown that both the quantity and quality of education for blacks is increasing faster than that for whites [3]. Thus the *age difference* in human capital stock is greater for blacks than for whites—older black people received their education in grossly inferior, segregated schools. Education, therefore, is not held "as constant" over the age range for blacks as for whites in this equation because quality is not controlled for.

This is portrayed in Figure 2, which represents hypothetical *cohort* age/earnings profiles. These are the profiles of age cohorts over time, rather than a cross section of all ages at any point in time. Each curve represents a cohort; the bottom one might represent the life earnings of men who were age 20 in 1930; the next, men who were age 20 in 1940, and so on; the last curve representing the cohort of men age 20 in 1970. The dotted lines represent projections into the future. What we are observing in cross section analysis is the points connected by the downward sloping line.

This phenomenon is present to a lesser degree in all cross-section estimates of earnings by age, and it is the reason we find that the cross-section

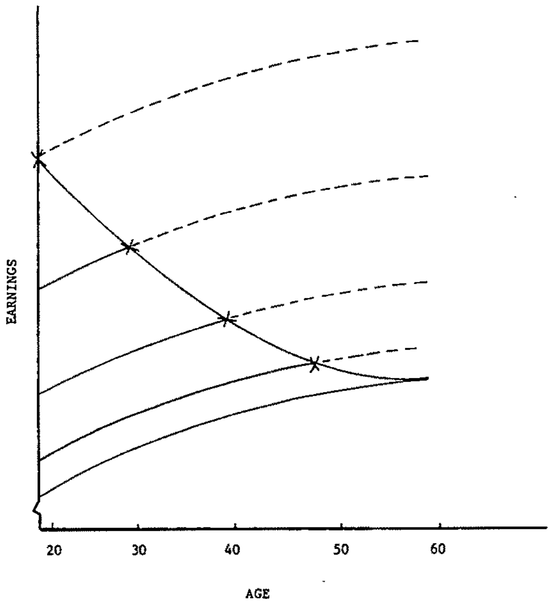

Figure 2. Hypothetical cohort age/earnings profiles

profiles begin to decline after about age 45 (whereas *over time* most people at age 55 are earning more than they did at age 45). But the vertical distances between these cohort profiles are likely greater for blacks than for whites among the younger cohorts, and they may in fact be large enough to result in a downward sloping curve when estimated from cross-section data. One can, in fact, draw a reasonable set of cohort profiles which, when connected as shown in Figure 2, would yield a cross section profile which is U-shaped, the same as in Figure 1 (through perhaps not as extreme).

Turning to other variables in the regression equation, the next two relate to family composition. The first (15) is a binomial dummy in which a value of one indicates that one or more adults other than the central family reside in the household.[11] The next variable (16) is the number of unmarried children less than 21 and living at home. Both variables have a positive effect on the husband's wage income, but only the latter is significant and then only at the .10 level. The usual explanation for this positive relationship is that a larger number of children result in a greater need for income, hence the father of a large family will tend to earn slightly more than if he has less dependents to support.

Counter to expectations, those husbands with business income had *higher* wage income ($168 per quarter, variable 17). The hypothesis with respect to part-time farmers was weakly supported by the regression—they had less wages and the size of their farming operation (represented by acres operated, variables 18 and 19) was negatively correlated with wage income, but operating 40 acres only reduced wages by an average of $10 per quarter.

Interestingly, nearness to a larger town (over 10,000) resulted in higher wage income: for every mile farther away, quarterly wage income declined by $8 (variable 20). The unemployment rate in the area (variable 21) was also an important explanatory variable, indicating that as the unemployment rate increased one point, quarterly wage income declined by $30.

The seasonal dummies (22–24) were highly significant as a group, and each was individually significant at the .15 level or less, but the differences among the coefficients were surprisingly small. They show that earnings in the Winter (Season 1) were only $75 per quarter or $25 per month lower than in the Summer. Wage income in the Spring was almost the same as in the Summer ($4 per quarter less), while Fall income declined from the Summer level by an average of only $_7 per quarter.[12]

The variables "quarter" (25) and "quarter squared" (26) were included to capture the trend in wage income over the three years. As discussed previously, the average income of the sample rose over that period.

Two other variables are of some interest. Farm-hands (variable 27) earned $68 per quarter or $272 per year less than other wage earners, after controlling for the other factors in the regression. The variable representing other income of the family (28), which includes the wages of other family members and all unearned income, is not at all significant (.86 level).

The two remaining variables in the regression, health conditions preventing work (29) and full-time job training (30), were simply introduced to control for these infrequent situations in case they might be correlated with one or more of the other independent variables. As expected these coefficients were negative, large, and highly significant.

To summarize the regression results, they show (1) that age and education are important variables in explaining variation in the wage income of husbands of low-income families and that they operate differently by race; (2) that there appears to be a good deal of racial discrimination in rural nonfarm labor markets and, if anything, our estimates tend to minimize this effect because the sample is restricted to low-income families; (3) distance from a larger town has a significant effect on wage income; and (4) seasonal fluctuations in the wage income of low-income rural nonfarm husbands are surprisingly small. Similar regressions to explain variation in the wage income of wives, not reported here, show even smaller fluctuations, with a difference in earnings of only $17 per month between the Summer and Winter. Regressions on total family income show the difference between the two seasons to be about $80 per month, with roughly half of that due to summer earnings of dependents.

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[11] The central family is defined as the husband and wife and all unmarried dependents less than age 21.

[12] The seasonal dummies are coded such that the omitted season, the Fall, is the sum of the coefficients of the other three seasons and opposite in sign. Thus the implicit coefficient for the Fall season is $7.27.

Concluding Remarks

One cannot advocate income and manpower policies for the rural nonfarm sector on the basis of a sample of 146 families, even though they were chosen to represent the Southeast and West North Central regions. We need more research on rural nonfarm labor markets and on the characteristics and behavior of the people who live there. Nonetheless, the findings presented in this paper lend support, at least, to three policy directions.

The first is a conscious policy to raise wage rates in the rural nonfarm sector. While unemployment contributes to income insufficiency of non-aged, male-headed families, it is not the major problem. Over 95 percent of the husbands in this sample worked in any given quarter, and they averaged over 40 hours per week and slightly more than 48 weeks per year. The wives, especially of the black subsample, also had a high degree of work involvement. For virtually all of the families in this sample, the major cause of low incomes was low wage rates. In fact, one-fourth of the husbands and an amazing 70 percent of the working wives received less than the minimum wage of $1.60 per hour. This suggests that they are either working in uncovered industries or the minimum wage law is not being enforced.

Attention must be given, of course, to the relationship between wage rates and the unemployment rate, but it is likely that a policy to raise wage rates in the rural nonfarm labor market would greatly benefit low-income families with a head of working age. Such a policy might involve expanded coverage of the minimum wage, raising the minimum wage, as has recently occurred, and perhaps providing incentives for unionizing more workers in the rural nonfarm sector.

A second policy suggested by these findings is to reduce racial discrimination. This might be accomplished by more vigorous enforcement of antidiscrimination laws in employment, such as the Civil Rights Act, an insistence on equal opportunity of employment when federal or state funds are involved, and government funding of affirmative action programs aimed at small businesses.

Lastly, it is the very group under consideration here—the working poor and near-poor—who are not covered by welfare. Passage of a negative income tax like the one presently being developed by HEW would provide a modest income supplement to those families. Roughly three of every five families in this sample would receive some cash assistance. Those with no income would receive from $200 to $300 per month, depending on family size. However, the average supplement for all families eligible would be in the neighborhood of $40–$60 per month.

To conclude, then, the findings of this analysis suggest that the most progress can be made in alleviating low incomes of working-age families in rural nonfarm areas by raising wage rates, reducing racial discrimination, and extending income-conditioned cash transfer programs to male-headed families.

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Economic Implications of Unemployment Insurance for Agriculture

STANLEY K. SEAVER AND JAMES S. HOLT

MANY OF YOU will recall that the Social Security Act of 1935 led to a federal-state system of unemployment compensation which provided a source of income to workers experiencing temporary involuntary loss of employment. However, with the exception of Hawaii, Puerto Rico, and the District of Columbia, there is presently no provision either in Federal or State law that provides mandatory unemployment insurance protection for workers in agriculture.[1] This situation is not unique, since agricultural workers were excluded from many federal and state labor laws. However, recent labor legislation such as minimum wages, workmen's compensation, disability insurance and others, has shown a trend toward extending to agricultural workers a status similar to that of industrial and trade workers.

As early as 1954 the Eisenhower Administration proposed to extend unemployment insurance coverage to workers in agricultural processing industries. The 91st Congress considered agricultural coverage as part of the Employment Security Amendments of 1970. The Senate approved extension of coverage, the House did not, and agricultural coverage was rejected by the House-Senate Conference Committee.[2] In rejecting the inclusion of agricultural coverage the Conference Committee was concerned about the paucity of factual information for assessing the effects of extending coverage to agriculture. The Bill signed by President Nixon included a directive to the Department of Labor to study the impact of extending coverage to presently excluded groups, with first attention to agriculture. It is rather ironic, and probably a reflection on our profession, that almost 40 years of unemployment insurance experience had passed without a *major* effort to investigate such an important economic and social issue.

Primarily as a result of the Congressional mandate, a regional research project was jointly funded by agricultural experiment stations of the Northeastern states plus Ohio, Florida, and Texas and contract funds from the Unemployment Insurance Service, Manpower Administration, U. S. Department of Labor. The resulting regional research project, known as NE-58, was probably one of the largest interregional research efforts ever undertaken by members of the profession—largest in terms of cost, number of states involved, and the immense volume of data collected. The project has been productive, generating a great deal of information which provided direct input into the decision making process on unemployment insurance legislation. It also has provided a great deal of data from which analyses of other agricultural labor issues have been and can be undertaken. While the intention of this paper is not to report all the results of this project, much of the data cited herein were derived from this study.[3]

With the results of the study available, the Nixon Administration in 1973 proposed that coverage be extended to agricultural employers with four or more workers in each of 20 or more weeks or a $5000 payroll in any calendar quarter. This is in contrast to present non-farm coverage, which includes all employers with one or more workers for 20 or more weeks or $1500 payroll in any calendar quarter, and continues a tradition of less extensive application of labor laws to agriculture than prevails in commerce and industry. Both the Senate and House have held hearings on the Bill, but at this writing no action has been taken.

The purpose of this paper is to explore the economic implications of the extension of unemployment insurance to agriculture. In some cases research analyses or empirical data are available to flesh out the discussion of these implications. In other cases we must rely upon raising issues and posing questions.

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[1] Minnesota extended coverage to agricultural workers in 1974, and legislation is pending in several other state legislatures.

[2] Employees of institutions of higher learning fared better than farm workers in the Employment Security Amendments of 1970; they *were* extended coverage.

[3] The principal reports resulting from the study were [1] and [3]. More detailed state reports are available from most participating states.

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How Unemployment Insurance Works

Since direct experience with unemployment insurance of many in the profession has probably been limited, a brief non-technical description of how unemployment insurance works seems in order.

The unemployment insurance system is a federal-state cooperative system. In barest outline, taxes are collected on payrolls of covered employers while people are working and benefits paid out to eligible workers who become involuntarily unemployed. Basic coverage and taxing provisions are shaped by federal law, but states are free to go beyond federal coverage standards and many do. Federal law has little to say concerning the dollar amounts of benefit payments to eligible beneficiaries, and a wide array of practices are in effect in different states.[4]

"Coverage" under unemployment insurance applies to employers with specific kinds of employment. Since January 1, 1972, covered employers must pay taxes on the first $4,200 of wages of employees engaged in work specified as subject to the tax. In a few states employees also pay a tax. Many states permit employers to elect coverage, but relatively few workers are covered on this basis.

Workers who are involuntarily unemployed may become eligible for benefits after having worked for a covered (i.e., tax paying) employer. To receive benefits, a worker must have had enough time and/or earnings in covered employment to meet minimum criteria that assure he was actually in the labor force and not merely a casual worker. The specific eligibility requirements vary by state.

The weekly amount and duration of a worker's benefits depend on the amount of covered employment and wages received during some previous "base period." Workers may be disqualified from receipt of benefits if they voluntarily quit their jobs or if they are fired for misconduct. While they are receiving benefits, they must be available for work, able to work, and must accept suitable work if it is offered.

The tax paid by employers is determined by a formula based on a number of factors. However, the major determinant of an employer's tax rate is his "experience rating," or the benefit claims of his former workers which have been charged against him. Minimum tax rates for an employer against whom few or no benefit charges are made can be as low as a few tenths of a percent of taxable payroll. (All covered employers must pay a 0.5 percent federal tax for administration of the system.) All state laws set maximum tax rates (in most states about 4 percent of taxable payrolls) for employers regardless of the unemployment experience of their former workers.

The extension of this unemployment insurance coverage structure to agriculture obviously has implications for actual and potential farm employers and workers, other agricultural producers, consumers, the unemployment insurance system, and those affected by it, including non-agricultural employers. These implications are explored in the remainder of this paper by first examining the direct, short run effects of coverage, without assuming any changes in the structure or functioning of the agricultural industry or labor force and second, by examining some of the longer run implications of these direct effects.

The Direct Effects of Extension of Coverage

Coverage of employers

Since workers become covered by unemployment insurance by virtue of working for covered employers, it seems useful to begin by assessing employer coverage. According to the latest agricultural Census data, only about 62 percent of Economic Class 1 through 5 farms (those with gross sales of $2,500 or more in 1969) hired any labor, and many of those who did hired very little. In the 15-state study only 21 percent of the agricultural employers hired enough labor in 1969 to meet the coverage criteria of the present administration proposal. However, these employers hired 69 percent of the agricultural wage-items employed in the study area, indicating that it is possible to achieve substantial coverage of workers without covering substantially all employers.[5] Obviously these results vary with the structure of agriculture in any given state. In Florida, for example, the Administration proposal would have covered 51 percent of the agricultural employers and 95 percent of the agricultural wage items. An extrapolation of present trends toward increased labor use on farms hiring labor suggest that coverage would become more extensive over time even if the legislation is made no more comprehensive than is presently proposed. If, however, the present non-agricultural coverage standard of one or more workers in 20 or more weeks or a $1,500 payroll in a calendar quarter were applicable to agricultural employers, it would have covered 89 percent of the employers in the study area in 1969 and 96 percent of the agricultural wage items [1, p. 2.12].

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[4] Pending Federal legislation, in addition to extending coverage to agriculture, also calls for minimum benefit standards in all states.

[5] In discussing coverage of employers' workers, it is necessary to use the concept of a "wage-item" rather than an individual worker. An individual worker is a "wage-item" on each farm on which he is employed during the year.

Just as the extent of coverage will vary by geographic region, so too will it vary by farm type. In 1969 the proposal now before Congress would have covered only 11 percent of dairy farms. The dairy farms covered employed 34 percent of the wage items on all dairy farms [1, p. 2.60]. Relatively few field crop or general farms would have been covered. In contrast, nearly half the fruit, vegetable, and miscellaneous farms and more than 80 percent of the wage items on these farms would have been covered in 1969. These are the farms on which seasonal workers tend to be concentrated.

Coverage of workers

Workers can only become unemployment beneficiaries after first having covered employment, so estimates of beneficiaries and benefits paid will depend upon the extent of employer coverage. It will also depend on the behavior of hired agricultural workers. The high degree of seasonality of some agricultural *employment* is often inputed, frequently incorrectly as we shall see, to agricultural *workers*. This has led to the notion that agricultural coverage would lead to expensive benefit payouts.

In measuring the impact on workers, it is useful to distinguish between *potential beneficiaries*, those who have enough covered employment and earnings to qualify for benefits, and *actual beneficiaries*, those potential beneficiaries who experience some compensable unemployment in any given year. Only a portion of potential beneficiaries become actual beneficiaries.

One fourth of the hired farm workers in the study area had worked during the study year in covered non-farm employment, and three-fifths of these, or 15 percent of all agricultural workers, already qualified as potential beneficiaries under existing legislation. Had the present administration proposal prevailed in 1969, 62 percent of the hired agricultural work force would have been potential beneficiaries. Even if *all* agricultural employment was covered without regard to size of employer, only 75 percent of agricultural workers would be potential beneficiaries [1, p. 3.14]. The other one-quarter had too little employment and earnings to qualify irrespective of the coverage provision.

The study indicates that about 5 percent of the hired agricultural work force had enough covered *non-agricultural* employment to become potential beneficiaries, and also experienced some weeks of compensable unemployment during the year and thus could become actual beneficiaries based solely on their covered non-farm work. About 20 percent of the agricultural workers would become actual beneficiaries under the administration's proposal, and 22 percent would become actual beneficiaries if all farm work were covered [1, p. 3.16].

Generalizing from the results of the study, the popular notion that practically all agricultural workers would be collecting benefits appears decidedly in error. About a quarter of them do not have enough employment to qualify for benefits, even though their employment is highly "seasonal" or sporadic, and more than half do not experience sufficient unemployment to receive benefits. This leaves slightly less than one quarter of the agricultural work force as likely to receive benefit payments in any given year.

Benefit amounts and benefit cost rates

If all agricultural work were covered, it was estimated that actual beneficiaries would have received average unemployment insurance benefits of $385 under the benefit standards prevailing in the various states at the time of the study. Average benefits to actual beneficiaries changed very little under different coverage provisions. Even among agricultural workers who were already actual beneficiaries because of their covered non-farm work, average benefits without farm coverage were $351 [1, p. 3.21]. Thus the major change resulting from covering agricultural workers lies in the increase in the number of beneficiaries and not in the average benefits received per beneficiary.

One of the crucial questions concerning agricultural coverage is the relationship between benefit payout and tax intake in such a highly "seasonal" industry. This question has been somewhat muted by the findings already demonstrated, that many of the most seasonal in the agricultural work force do not qualify for benefits. (Their wages do, however, generate tax revenues.) Assuming the payroll tax rates applicable to new employers in the study states, the average benefit-cost rate (benefit payments expressed as a percent of taxable payrolls) attributable to agricultural coverage would have been 3.0 percent. Variations were considerable among states, depending upon the percentage of workers qualifying as beneficiaries and the amount of benefits they qualified for, Table 1.

Although the average benefit cost rate for the 14 states study region and many individual states, was less than the legal maximum tax rate, this does not necessarily imply that agricultural coverage would be "self-supporting." The contribution rates of firms whose workers are paid few or no claims would gradually fall to the state's legal base limit. The contribution rates of firms whose workers experience substantial unemployment would rise, possibly to the state's maximum permissible tax rate. The cost of benefits to firms whose workers experience substantial unemployment may exceed the state's maximum tax rate. In such cases the excess benefit-costs of these firms are financed by adjusting upward the contribution rates of all other covered employers paying less than the maximum tax rate. The extent to which this would occur in any state depends on the extent to which the estimated average benefit-cost rates actually typify individual firm costs, or whether there is a large variation around the average.

Table 1. Estimated benefit-cost rates and added cost rates for agriculture under full coverage by state, 1969–70[a]

State	Benefit Cost Rate[b]	Added Cost Rate[c]
Study Area (14 State Average)	3.0	3.0
New England		
Connecticut	6.7	6.7
Maine	2.1	1.7
Massachusetts	3.0	3.1
New Hampshire	2.4	2.6
Rhode Island	5.1	5.1
Vermont	0.8	0.8
Mid-Atlantic		
Delaware	5.1	5.1
Maryland	1.5	1.6
New Jersey	5.8	5.8
New York	1.6	1.6
Pennsylvania	1.6	1.8
West Virginia	1.4	1.5
Ohio	4.0	4.0
Florida	3.0	3.0
Texas	NA	NA

Source: [3, p. 4.3].

[a] Both rates are based upon an allocation of benefits and taxable earnings to the states in which they were earned.

[b] This rate is the proportion that benefits allocated to agriculture earnings are of taxable agricultural earnings.

[c] The added cost was obtained by computing total benefits based on all present earnings of agricultural workers in covered non-farm employment plus earnings in farm work, then subtracting benefits based on non-farm covered earnings only. The difference, the benefits added by extending coverage to agriculture, divided by taxable agriculture earnings is the added cost rate.

Incidence of benefits

Those workers not qualifying as potential beneficiaries, and therefore, essentially totally untouched by the extension of unemployment insurance to agriculture, are those with relatively little employment and earnings. These are primarily housewives and students. For example, data from Pennsylvania [8] showed that nearly three quarters of those not qualifying as potential beneficiaries were youth 17 or under. About one quarter were female; however, there was some overlap in the sex and age classifications. Local workers were less likely to be potential beneficiaries than other workers, reflecting the fact that most youth and housewives in the agricultural labor force were non-migrants.

Migrant workers tended to benefit significantly more than others because a high proportion of them qualified as potential beneficiaries, and they also had a relatively high incidence of compensable unemployment.[6] With all agricultural employment covered, 39 percent of migrants in the regional study were estimated to be actual beneficiaries compared to 15 percent of local workers. Since a substantial proportion of migrants were members of minority groups (blacks, Puerto Ricans, and Mexicans) this also means that a substantially higher proportion of minority group workers than white majority workers are likely actually to receive benefits. With all agricultural employment covered, migrants constituted 52 percent of the actual beneficiaries although they comprised only 28 percent of the worker population. However, restricting coverage to the administration's proposal disqualified proportionally more migrants than non-migrants from receiving benefits (12 percent compared to 9 percent), and coverage provisions more restrictive than the administration's proposal had a drastic effect on migrants. For example, the proposal to cover agricultural employers with 8 or more workers in 26 or more weeks disqualified 36 percent of the migrant actual beneficiaries compared to 19 percent of the non-migrants [1, p. 4.13]. Thus the selection of the appropriate coverage provision cannot be assumed to have uniform effects on all classes of workers.

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[6] Migrant workers were defined consistent with the definition used in the Hired Farm Working Force Reports, Economic Research Service, USDA.

Secondary or Longer-Run Effects of Coverage

The analysis which yielded the above estimates assumed no change in labor supply or demand, or the labor force behavior of workers resulting from the extension of unemployment insurance. However, the direct effects of extension of coverage are likely to lead to a number of longer-run adjustments whose magnitude and direction can only be speculated upon. The remainder of this paper will attempt to focus on some of the more important likely long-run implications of the extension of unemployment insurance to agriculture and arrive at some generalizations despite the inherent difficulties. This discussion will be divided into effects on employers, workers, and the unemployment insurance system.

Effects on employers and production

Much of the debate on the extension of unemployment insurance to agriculture has centered on speculation as to its impact on employers, and ultimately on volume of production and product cost. There has been speculation about exorbitant tax rates to fund benefits, and drastic restrictions on labor supply that supposedly would result from workers opting for unemployment insurance benefits upon becoming eligible, either reducing production or increasing payroll costs or both.

Although these issues must be addressed, the mechanics of unemployment insurance are designed to protect against drastic effects of this sort. While high benefit costs may result from covering a group of workers, the provision of a maximum tax rate prevents the incidence of this from falling entirely on one group of employers. Benefit costs in excess of those recovered from employers at the maximum tax rate are shared by all employers in the system. This, of course, raises other issues that will be dealt with later. However, the estimated industry average benefit costs cited earlier suggest, although they do not prove, that exorbitant benefit cost rates are not likely to occur except in unusual cases.

It is entirely possible, in fact likely, that the availability of unemployment insurance will have some impact on workers' labor force decisions and thus labor supply. Several plausible hypotheses as to the nature of these decisions could be posited, and more will be said on this point in the next section. Unemployment insurance procedures require that in order to be eligible for benefits, beneficiaries must be available for work and accept suitable work if it is offered. This requirement is difficult to administer to perfection, but it does provide a safeguard against wholesale desertion of the labor market. With respect to the present proposal, let us assert that a drastic decline in labor supply seems unlikely.

In the short run, in the absence of compensating adjustments, the unemployment insurance tax on covered employers would result in increased production costs which would shift the marginal cost curve upward and to the left and, assuming perfect competition in the product market and no change in product demand, would reduce the firm's profits after imposition of the tax. Marginally profitable firms might be forced into a zero or negative profit situation.

One longer-run adjustment to this circumstance could be reduced output (mainly via exit of firms) and increased product prices. A second longer-run adjustment could be a recombination of factors of production due to a change in relative factor costs. An increase in the cost of hired labor coupled with unchanged capital and land costs would lead to a reduction in hired labor employment. From the standpoint of efficiency in the utilization of labor, unemployment insurance might well be a blessing in disguise. There is evidence (not nearly enough) that agriculture does not utilize labor efficiently, especially seasonal and so-called "crew labor," which would be the kind that led to high tax rates. Unemployment insurance may provide an incentive for greater efficiency in the use of such labor. At any rate, the need for investigation of the effect of unemployment insurance upon factor prices, combinations, efficient utilization, and production costs is sufficient to provide some enterprising graduate students with excellent thesis topics.

Labor cost increasing tendencies of the unemployment insurance tax, to the extent that they occur at all, would not affect all farms equally. It is not likely, and current proposals do not require, that all firms be covered. Many farms with small hired labor forces will likely escape coverage and thus not incur the payroll tax. Unemployment insurance therefore may enhance the competitive position of small farms *vis-à-vis* larger farms.

Furthermore, the cost effects for farms that do qualify for coverage will likely differ significantly as between types of farms. In the short run (two years) all employers who qualify for coverage pay a minimum tax which varies by state. After this period each employer receives an experience rating based upon the payment of benefits to his former workers. Dairy farms have greater stability of employment among their workers than, for example, vegetable farms. Therefore it is likely that after the experience rating period, dairy farm employers would on the average pay lower tax rates than vegetable farms.

Because of experience rating, employers tax rates may also vary depending upon the employment pattern of the workers hired. Employers who can recruit workers who are unlikely to qualify for benefits, or for only small benefit amounts, such as housewives and students, may incur a low experience rate, even though their employment pattern is highly seasonal. The use of "moonlighters" who hold regular non-farm jobs would also become advantageous. This may lead to some conscious changes in employer recruiting behavior. It may also provide an advantage to employers of seasonal workers in surplus labor markets who would have a pool of "low-cost" (in the unemployment insurance sense) workers relative to employers in the more sparsely populated rural areas where migrant crews are the only source of seasonal labor.

There are also possibilities of interregional differences in unemployment insurance and related labor costs. Where factor combinations per unit of output differ substantially between regions, or where the employment patterns of the agricultural work force are such as to produce differences in benefit costs which would lead to differences in employer tax rates among regions, there could be some interregional differences in labor costs per unit of production. The fact that some regions have larger firms and employ more hired labor will mean only that such firms pay a larger absolute tax than those of other regions. It will not mean differing production costs per unit of output unless factor combinations between regions differ significantly. Significant differences in the proportion of labor from family versus hired sources would produce some cost advantage to the farms operated with family labor. Dairy and poultry might experience some differing regional impacts arising out of differences in the source of labor. On the whole, however, we feel it is doubtful that the cost differences between regions for most commodities will be great enough to disturb the present regional production patterns.

A product such as cotton may be a different story. The larger labor inputs per unit of output in the South as compared to the West may put Southern cotton producers at a cost disadvantage. A similar situation may obtain with respect to vegetable production. Frankly, there are sufficient unanswered questions surrounding the area of interregional competition in relation to unemployment insurance to encourage additional inquiry.

International trade should not be ignored, and fresh fruits and vegetables are vulnerable. Some fruit and vegetables are now under severe international competitive forces. While a constantly increasing amount of capital has been employed in producing fruits and vegetables, they nevertheless still employ large quantities of labor. The additional costs associated with unemployment insurance could mean that some vegetables and fruits cannot be produced at world market prices. This is an area of inquiry calling for attention.

Not all the cost impacts of covering agriculture will necessarily be cost increasing. Mention was made earlier of the possible improvements in hired labor efficiency which the unemployment insurance tax may inspire. Perhaps a more likely positive cost impact may come about through a change in labor supply. Extension of unemployment insurance coverage to agriculture will remove one more of the characteristics that set hired agricultural work apart from non-agricultural employment. It will be one step, albeit a small one, toward equality among sectors of the labor force. Presumably it will have some positive effect, as an added fringe benefit, in improving the willingness of workers to take agricultural employment and reduce job turnover, with a reduction in the attendant hidden labor costs of lost production, recruitment, and training of replacements. While there is little evidence that the present agricultural work force yearns for unemployment insurance coverage, once coverage is actually effected there should be some positive effects on total labor supply and hence costs.

Finally, the relative importance of hired labor expenditures must be considered, to put the discussion in perspective. The 1969 Census of Agriculture showed hired labor expenditures to constitute about 9 percent of total farm production expenses on Economic Class 1 through 5 farms [7]. Since the unemployment insurance tax could add, at most, 4 to 5 percent of the labor bill, it would on the average have a negligible effect on farm production costs. Even on farms with gross sales of $100,000 or more in 1969, hired labor expenditures averaged less than 12 percent of farm production expenses. However, hired labor expenditures on fruit, vegetable, and miscellaneous farms averaged from one-quarter to one-third of farm production expenses on Economic Class 1 through 5 farms, and increased to from 30 to 40 percent of farm production expenses on farms with gross sales of $100,000 or more. On large farms of these types, farm production and ultimately product prices may be considerably more sensitive to hired labor costs.

Effect on workers

The extension of unemployment insurance to agriculture will have some long-run impacts on agricultural workers and the agricultural work force in the aggregate. Perhaps the most important of these are its potential impacts on the level and composition of employment, workers' labor force behavior patterns, and migratory patterns.

The added incentive to substitute capital for labor resulting from the possibility of increased labor costs has already been noted. The advent of unemployment insurance will surely add at least some additional pressure to this already strong and long standing adjustment pattern.

Some additional seasonal unemployment will almost surely result too. It can hardly be denied that some farmers presently finance their own "unemployment insurance" by retaining good workers on the payroll during periods of slack labor demand to maintain a labor force during normal and high demand periods. The extent to which employers can shift this burden to the unemployment insurance system, and the extent to which workers will be willing to settle for the lower income levels afforded by unemployment insurance, is a topic warranting further investigation.

The use of unemployment insurance as "rocking chair money" to provide additional income to seasonal workers who, by accident or design, earn enough to qualify for benefits, but whose employment in any case would be seasonal, is likely to occur in some production sectors of agriculture as it is alleged to occur in agricultural processing. This would appear to provide a net gain to both agricultural employers and workers at the expense of the unemployment insurance system and other covered employers.

It has already been noted that an incentive would be created to meet labor requirements with permanent workers and seasonal workers unlikely to apply for or qualify for benefits. This would appear to put housewives, students, retirees, and industrial moonlighters at an advantage relative to migrants working at a succession of seasonal farm jobs. However, the cost of assembling such a work force, and possibly its lower productivity, may be enough to offset higher unemployment insurance costs associated with more experienced and organized seasonal workers.

The impact of coverage on worker's labor supply and migration decisions provides room for further interesting research. It seems likely that some seasonal workers not now qualifying for benefits would be induced to increase their employment sufficiently to qualify. Whether there would be opportunity for them to do so and how the unemployment insurance system will treat seasonal agricultural workers administratively are unknowns at this point. Whether some workers would, and could administratively, be induced to accept unemployment insurance payments in lieu of higher earnings is also dependent upon factors which are largely unknown.

This question has special relevance to migratory workers. Since there is generally little or no seasonal agricultural work in their home areas when they enter the migratory system, it is likely that many workers now entering the migrant stream would be considered administratively as qualifying for benefits if they had sufficient employment and earnings in their "home state." Whether they would choose to migrate, if eligible for benefits at home, is dependent on their assessment of the utility of additional income relative to the disutility of migration. Emerson [4] at Florida estimated that if all migratory workers in the regional study did not migrate to any job if employment in their home state would make them eligible for benefits, their foregone earnings, net of additional unemployment insurance benefits, would average $687, or 22 percent of their average total earnings including that from migrant work. To what extent workers would be willing to make such trade-offs warrants further research.

If the extension of unemployment insurance reduced migration significantly, the labor markets in the supply states (primarily Florida, Texas, and California) would not be greatly affected. But in demand states, assuming a relatively inelastic demand for labor in the short run, large wage increases followed ultimately by mechanization, shifts in production, and disappearance of some producers would likely result.

While the supply states' labor markets would not be greatly affected, these states could face important social and community disruptions. Educational, health, and welfare costs would probably increase significantly, since it is unlikely that migrant families as part-time residents of a community presently make heavy demands upon local government services. The effects of reduced migration upon property taxes, the tax burden of present residents, and eventually upon the level of services provided can only be surmised.

Finally, it is relevant to ask what impact unemployment insurance will have on agricultural workers' incomes. The low earnings of agricultural workers are frequently cited in support of the extension of unemployment insurance to agriculture. It can be expected to have little impact on the general low income problem among farm workers [3, p. 6.4]. Low earnings among farm workers appear to stem chiefly from low labor force participation and low wage rates. To the extent that low labor force participation is voluntary, and much of it is accounted for by housewives and students, it is not really a social "problem."

Youth, part-year, and part-time workers collectively accounted for more than 20 percent of the regional study population and more than 40 percent of those with total earnings from all sources of less than $3000. Practically none of these workers would become unemployment insurance beneficiaries. About one-half the study population worked full-time and experienced no compensable unemployment and thus would not receive any benefits. This group accounted for one-quarter of the workers with earnings of less than $3000. Those workers who would receive virtually all the benefits were the full-time workers with some weeks of compensable unemployment. They comprised about one-quarter of the work force, and about one-third of the workers with annual earnings of less than $3000, and received about 98 percent of the unemployment insurance benefits. About two-thirds of the benefits accrued to workers with total earnings under $3000, and payments were large relative to their annual earnings, for example $463 for workers with total annual earnings of $1500 to $3000. It appears that unemployment insurance has the potential for making a substantial impact on the welfare of only about one-quarter of the agricultural work force.

Impact on the unemployment insurance system

In some states the benefit outlays from the addition of agricultural coverage will exceed the taxes paid by agricultural employers. In Connecticut, for example, the annual drain on the fund was estimated at between $750,000 and $950,000. This is small in terms of a reserve fund of $100 million which has existed in some recent years, or the increase of about one-tenth percent for non-agricultural employers which would be required to cover these excess benefit costs. But any increase in taxes is unlikely to receive ardent support in the legislature by non-agricultural employers, especially during periods of high unemployment and low reserve funds, such as at present. In California the estimate of the annual deficit caused by agricultural coverage is approximately $30 million [5, p. 9.2].

There are, of course, equity considerations to be taken into account. Many presently covered firms, and some whole industries, are not "self-supporting." The fact that agriculture, in some states and in some years, is likely to generate excess benefit costs is not unique.

There has been some concern about the additional administrative load that would be placed on the unemployment insurance system by adding agricultural coverage. This was undoubtedly one of the considerations in the Administration's decision to propose less extensive coverage for agriculture than is applicable to commerce and industry.

Comparing the estimated number of added employers resulting from extending coverage to agriculture in 1969 to the employers already covered in that year yielded percentage increases in the number of covered employers ranging from 0.6 percent in Rhode Island to 32 percent in Texas [1, p. 5.11]. Only in Maine, Vermont, and Texas was the percentage increase in covered employers 10 percent or more. Less than complete coverage of all agricultural employers would reduce these percentages significantly. Estimated additional taxable wages resulting from agricultural coverage ranged from 0.3 to 4.3 percent, and estimated additional benefits paid was less than 4 percent in all study states except Florida, where estimated additional benefits were 18.6 percent of those paid in 1970. Although no comparison of the relative increase in volume of interstate claims resulting from agricultural coverage was made, it would almost certainly be more than proportional to the increase in the number of beneficiaries. The effect of the additional coverage on the administrative costs of unemployment insurance was not studied, but it appears that coverage of all agricultural employment and full participation by eligible beneficiaries would increase the number of employers and benefit accounts more than proportionally to the increase in taxable wages which provide the basis for funding the administration of the system.

However, the question of the likely level of participation must also be raised. The estimates presented earlier were based upon the assumption that all those workers who become eligible for unemployment insurance benefits would file and collect. Evidence suggests that large numbers of eligible workers never file claims for benefit payments. Estimates for non-agricultural workers runs as high as 30 percent [6]. Nonparticipation is likely to be even higher during the early years due largely to the fact that many workers will not know or understand their rights and benefits under unemployment insurance coverage [5]. In addition there is evidence that rural people have a lower participation rate in government related programs of all types than their urban counterparts [2]. For some, of course, participation in almost any government program of assistance involves a social stigma. For whatever reasons, the economic implications of less than full participation is that tax rates will be lower than those estimated in the regional study.

The question of program participation also has important implications for agricultural extension. We assume that a major portion of the responsibility for informing farm workers of their rights and benefits under unemployment insurance will fall upon the Agricultural Extension Service. Non-agricultural workers have depended upon their unions to carry much of the educational burden of unemployment insurance rights and benefits. But agricultural workers generally are not members of labor unions; hence, Extension may need to mount a major labor educational program. Can Extension easily adopt to having farm workers and employers as bedfellows?

Finally, we must address the issue of the continued separate treatment of agriculture in labor legislation. This is not only a question of administrative desirability, but of political expediency and social justice. Many oppose separate treatment. With respect to unemployment insurance Varden Fuller states ". . . the standards should be the same for everybody, both federal policy and state practices" [6, p. 14.2]. He went on to state that trying to maintain the differentiation between the rights of agricultural people and others may be unconstitutional and cited the exclusion of farm workers under the National Labor Relations Act and their inclusion under the Fair Labor Standards Act. Regardless of the Constitutional question, the stage is set for a political battle over coverage provisions.

In assessing the impact of extending unemployment insurance to agriculture, the profession has concerned itself with a major issue of the day. It is one that is squarely within the purview and responsibility of agricultural economists, but one that, aside from the efforts of a very few individuals, has for years been almost entirely ignored. Those of us associated with NE-58 are proud of our research accomplishments. But only a start has been made. The issues raised in this paper and many others require additional analysis. We hope to make available a wealth of data, but only you can develop an interest in this area of inquiry.

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Session 10

AGRICULTURAL AND RURAL LABOR RESOURCES

Discussants: Wallace Huffman, Oklahoma State University; James A. MacMillan, University of Manitoba; James Webb, University of Texas

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American Agriculture's Capacity to Meet Future Demands

G. E. Brandow

In embarking upon a topic that is full of uncertainties, the only thing I am sure of is that agriculture's capacity to produce is an important subject to many people. Consumers, shell-shocked by the rise of food prices of the past two years and facing the consequences of a bad drought, would like to know if relief is ever in sight. Concern about inflation of prices in general—not just food—is high; stability of food prices seems a necessary if far from sufficient condition for getting it under control. Faced by prospects of heavy outlays for imports, especially for oil, the nation hopes that high exports of farm products will help to balance its international account. Persons and agencies concerned about sources of food for hungry people in poor countries turn inevitably to the United States, already by far the leading net exporter of food and one of the most promising sources of export expansion. Farmers would like to know future output in order to form better judgments about prospective economic conditions in their industry.

Production or capacity figures by themselves are not very meaningful. What one wants to know is how potential production compares with amounts likely to be demanded at specified prices. Consideration of possible demands, however, makes an already complex problem especially difficult, for great uncertainty attaches to demands to be made on American agriculture as well as to agriculture's capacity to produce. Especially for a paper that must be listened to rather than read, it seems necessary to simplify the analysis rather severely.

One way to simplify is to focus upon a date sufficiently far in the future so that agriculture's production could be markedly different from its present level. The date should not be so remote, however, that we have no useful ideas about demands to be made on agriculture or about the determinants of farm output. I have chosen 1985 as a convenient target date. Another way to simplify is to choose two contrasting situations that seem enlightening about the many outcomes that might possibly develop. I shall try now to be explicit about the two benchmark situations to which I intend to give special attention.

Two Benchmark Situations

The first benchmark I call the standard situation because it represents the unfolding of trends that were established prior to the turnaround in food and agricultural affairs two years ago. One can reasonably argue that the basic determinants of supply and demand for agricultural products, especially in the aggregate, are such things as population, income, the flow of new production technology, and land devoted to agricultural uses. None of these characteristically changes direction abruptly or moves to new long-term levels overnight. Despite the deviant behavior of the past two years, it may turn out that the situation in 1985 is largely determined by the working out of forces already well established and clearly observable prior to 1972.

Several projections of future agricultural conditions have been made in the United States in the past half-dozen years [1–7, 10]. Though the target dates usually were not quite so far away as 1985, the studies strongly suggested what the situation in the mid-1980s would be like if past trends or relationships were to persist. The studies all pointed to adequate capacity on agriculture's part to meet prospective demands at ordinary prices. Usually some excess capacity was identified or implied.

Now it is easy to overlook indications that trends are changing, that a new set of basic relationships is emerging. The dramatic events of the past two years prompt a reexamination of the past decade or two to see if a new era has been clearly foreshadowed. I have, therefore, made my own projections for 1985. I should say at once that I have no startling new conclusions, though perhaps a somewhat different interpretation emerges.

The estimates for the standard situation in 1985 are built on assumptions that the U. S. population will grow at 0.8 percent per year, that the average income of consumers will rise as in the 1960s and early 1970s, and that past trends in consumer preferences will persist. Exports, in-

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cluding food aid, are assumed to change in ways typical of the years prior to 1972; in particular, the huge agricultural exports of the past two years are not treated as the starting point for projection into the future. On the supply side, government controls on production are considered to be absent. The flow of improved production practices serving to increase crop yields and livestock production is assumed to continue, though the particular forms it will take are not specified in detail.

Price relationships to which consumers, foreign buyers, and producers respond in the standard situation are assumed to reflect trends underway prior to 1972. Here there is a difficulty of exposition, for inflation is likely to have proceeded considerably further by 1985. In referring to standard or normal prices in 1985, I do not mean that the dollar-and-cent prices of the past will return. I mean, for example, that retail food prices will bear the *relationship* to the Consumer Price Index that was typical prior to 1972. I mean the *relationship* of farm product prices (supplemented, if necessary, by payments) to production costs will be consistent with pre-1972 trends. If one agrees that farm and food prices prior to 1972 were generally low to modest, then farm and food prices projected for the standard situation are low to modest.

Only by coincidence could all these assumptions be consistent. If it turned out that agriculture would produce more than was demanded at assumed prices, then agriculture would have excess capacity. If it turned out that demands exceeded output, then capacity would be deficient. Thus the projections are suited to looking at the capacity question but are not intended to show what the actual level of prices or production might be.

The second benchmark is intended to be illuminating about an alternative situation for 1985, one in which high demand puts a severe strain on agriculture's capacity to produce from now to 1985. A conclusion soon reached is that one of the most important variables for consideration is the future strength of export demand for farm products. Export demand might be great because our regular customers abroad bought much more, because Russia and China became large importers, or because the United States undertook to give vast amounts of food aid to poor countries. Very high export demand, provisionally of unidentified source, is the distinctive feature of the high-demand situation.

High demand is assumed to hold crop prices approximately as high in relation to costs as crop prices have been, on average, for the past two years. A strong economic incentive would exist, therefore, for expansion of farm output. High prices would reduce domestic consumption somewhat below levels projected for the standard situation. A large volume of agricultural products would be available for export. The system would be in neat balance if the strong export demand assumed for 1985 happened to be just sufficient to absorb the export quantities available.

No effort is made to concoct such a neat balance, however. Without it, the projections are useful for indicating the expansion in output of major crops that might be forthcoming in response to highly favorable prices to producers. The projections also suggest the volume of exports available for commercial sale or food aid and permit speculation as to how much could be accomplished with them.

The two benchmark situations by no means exhaust the potential outcomes for 1985. It is possible that energy shortages or restrictions on agriculture to protect the environment will materially impair agriculture's ability to produce. It is also possible that demand will be considerably weaker than projected even for the standard situation. A few comments will be made later on about the effects of such developments.

The Standard Situation

A large increase in demand for agricultural products is projected even for the standard situation in which forces at work prior to 1972 dominate the outcome in 1985. If the assumptions already described held true, the United States would have 11 percent more people than in 1973.[1] The average family, though by no means all families, would eat abundantly. Calorie intake would substantially exceed the amount needed if every person were to get the recommended dietary allowance defined by the National Research Council. Much more protein would be consumed (again, by the average person) than considered essential for good health, and a much larger proportion of the protein than a person usually needs would come from animal products. Per capita consumption of red and poultry meats would be 18 percent above the record set in 1971. Consumption of dairy products and eggs, however, would be down. The index of per capita consumption of all foods collectively would be 6 percent over the 1971 record.

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[1] Domestic demand projections applicable to crops in 1985 were for 1986 since most of the utilization of 1985 crops will be in 1986.

A substantial increase in livestock feed would be required to produce the larger volume of animal products. Domestic use for feed grains for this purpose would exceed the 1972 level by one-fourth; feeding of soybean oilmeal would rise more than one-third. Hay acreage, while down, would take nearly one-fifth of the cropland in use.[2]

Added to enlarged domestic utilization would be exports following trends established before the 1972 spurt. Projected exports for feed grains, wheat, cotton, and rice in 1985 would be below peaks reached in the past two years. Soybean exports, however, would be far higher. Both abroad and at home, rising demand for protein feed for livestock is focused on soybeans, of which the U. S. is the pre-eminent source. The perhaps surprising conclusion is that even for the standard situation, total exports of nine leading crops in 1985 would be 15 percent higher than the record set in the crop year just ended. Exports of grain for assistance to poor countries would be a significant but not dominant part of total exports.

Agriculture's capacity to meet demands for food, feed, and fiber crops will depend mainly on the amount of land and water used for crops, on the level of technology used in crop production, on the availability of inputs such as fertilizer, machinery, and fuel from industry, and on restraints on production methods that might be imposed to protect the environment. For the standard situation, I assume that production problems connected with energy shortages or environmental protection will not be serious enough to modify total output appreciably. Questions about production in the standard situation, therefore, center on the acreage likely to be used for crops and on yields per acre likely to result from water availability and changing technology.[3]

Estimates of land ready at hand for crop production have been somewhat uncertain because land was withheld from production by one government program or another from 1956 to 1973. A rule of thumb that worked fairly well was to say that 10 acres signed up in programs reduced total cropland harvested by seven acres. Estimates of land ready at hand for crop production indicate a slow downward trend since about 1950. Total cropland harvested is projected to be 325 million acres in 1985, slightly below the amount that would be harvested this year with normal planting and growing weather. This acreage, 325 million, seems likely to be cropped in 1985 even if crop prices are rather unfavorable to farmers. A large acreage probably would require distinctly favorable prices.

Crop yields per acre have been rising for four decades because of a complex combination of improved varieties, more fertilizer, more effective protection against diseases-insects-weeds, improved cultural practices, more irrigation, and so forth. The process producing the persistent upward trend in over-all yields is by no means ended if energy and environment do not become important restrictions, the assumption for the standard situation. In projecting yields per acre for the leading field crops, I tried to recognize any apparent slowing down of the rates of increase, and I made rough adjustments for the past effects of acreage diversion and changes in location of production on crop yields. The average projected yield per acre for 10 crops in 1985, with normal weather, was 20 percent above the 1971–73 average. The projected increase is only a little more than half the percentage increase in yields achieved in the preceding period of equal length.

Those of you with a strong interest in production will want to know some of the key yields estimated for 1985. They are: corn, 122 bushels per acre; wheat, 39 bushels; soybeans, 32 bushels; and cotton (the only crop for which no increase was projected), one bale per acre.

Though farmers are unlikely to make important changes in *total* harvested acreage unless prices depart widely from the standard level, farmers (given time) will shift land from one crop to another in response to rather modest changes in price relationships. On this assumption, enough land was assigned to each crop other than grains to produce as much as the market was expected to take in 1985. The remainder of the 325 million acre total was distributed among the grains.

It turns out that agricultural production capacity in the standard situation would exceed demand by a small margin. Surplus capacity, as a result of the way the calculations were made, would be concentrated in grains. Excess grain production would amount to 20 million tons, which would be 6 percent of total grain utilization in 1985. Or, put another way, the excess capacity would be equivalent to 2 or 3 percent of total utilization of all crops.

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[2] See Table 1 for projections of crop utilization and production in the standard situation.

[3] The emphasis on crops rather than on crops and livestock is partly for expositional purposes. Prospective changes in the efficiency of livestock production were taken into account in projecting feed requirements and are, of course, important. Additional export demand in the high-demand situation is considered to be concentrated on crops.

The projected excess capacity for 1985 is smaller than the actual excess capacity usually estimated for the 1960s. The excess is sufficiently small that it might be obliterated or doubled by a moderate error in projecting crop yields, domestic demand, or exports even if the favorable assumptions about energy supplies and environmental measures proved to be correct.

The High-Demand Situation

I next turn to the high-demand situation featured by huge exports that proceed upward from the high levels reached in the past two years. Estimates made for the standard situation suggest that agricultural capacity at standard prices would be deficient. Thus the assumption of crop prices generally as favorable to farmers as those of the 1972 and 1973 seasons might well be justified. The central question is, if such favorable price relationships persisted until 1985, how much might agricultural capacity be expanded?

A land inventory made in 1967 by the Soil Conservation Service of USDA [9] indicates that a surprising amount of land in the United States is not cropped but could be cropped, according to soil conservation criteria. On the other hand, some land now cultivated should not be cropped, from a conservation standpoint. One might infer from the inventory data[4] that harvested cropland could be increased 60 percent over the current level without violating soil conservation criteria.

This is an upper limit, however, that must be heavily discounted in appraising potential production capacity. More than one-third of the additional land is now in range and pasture and producing livestock feed that would have to be replaced if the land were put under the plow. This land and other potential crop acreage now in forestry are earning economic returns in their present uses and would not readily be shifted to wheat, feed grains, and similar field crops. Much of the land would require substantial investment to be brought into crop production.

The Economic Research Service of USDA recently made projections of agricultural production in 1985 under assumptions closely approximating those of my high-demand situation [8].[5] Drawing upon a much wider range of expertise than is available to me, ERS concluded that 350 million acres might be harvested in 1985. This is an increase of 25 million acres over the 325 million I projected for the standard situation. It seems to be a reasonable estimate of how much expansion high prices might generate in a decade.[6]

Favorable prices not accompanied by shortages of fertilizer or other inputs would stimulate more rapid increases in yields per acre than otherwise would be expected. On the other hand, much of the new land added to the cropped area would be less productive than the land already cultivated. I made two adjustments in my standard-situation yields to represent the high-demand situation: first, yields of grains other than wheat were increased 5 percent; and second, yields of wheat, which would be much expanded in acreage, were reduced from 39 to 36 bushels per acre. Yields thus estimated for 1985 in the high-demand situation averaged a little higher than ERS projections.

Total grain production thus estimated for the high-demand situation was, in the aggregate, 12 percent higher than for the standard situation. Larger output sharply increased the amounts of crops available to meet high export demand. Another source of greater export availability was reduced consumption at home. Faced by higher prices resulting from huge exports, consumers would cut back to some extent on food consumption and thus would release resources to meet demands from abroad.[7]

Some Other Situations

Before going on to consider what the projections for the two benchmark situations may tell us, I should say a few words about other possibilities.

The energy situation is very much on our minds now. Clearly, any substantial failure to

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[4] Also involved are appropriate assumptions about summer fallow and crop failure.

[5] I am grateful to ERS for making available to me unpublished details about its study.

[6] See Table 2 for projections of crop utilization and production in the high-demand situation.

[7] The contrast between the projections for the standard and high-demand situations implies a supply elasticity for total crop and total agricultural output well below unity. If "long-run" supply elasticity exceeds unity as some studies have suggested, the difference between the standard and high-demand situations is understated. Working on the projections revealed examples of the importance of the demand pattern to which agriculture responds, since this much influences the output mix.

Table 1. Standard situation[a] projections for crops, 1985

Crop	Acres	Yield	Production	Domestic Use	Exports	Excess
	mil.		mil.	mil.	mil.	mil.
Corn, bu.	61.0	122	7,442			
Gr. sorghum, bu.	16.5	70	1,155			
Barley, bu.	11.0	55	605			
Oats, bu.	9.1	61	555			
Feed grains, tons	97.6	2.70	264	219	36	9
Wheat, bu.	53.7	39	2,094	850	900	344
Rice, cwt.	1.8	52.6	95	36	48	11
All grains, tons	153.1		331	246	65	20
Soybeans, bu.[b]	71.5	32	2,288	808	1,480	—
Cotton, bales	12.0	1.0	12	7.5	4.5	—
Hay, tons	57.0	2.33	133	133	—	—
All other[c]	31.4	—	—	—	—	—
Harvested Acreage	325.0	120[d]		—	131[d]	

[a] Projection of pre-1972 trends in demands, yields, total acreage readily available for crops, etc. Usual pre-1972 price relationships assumed. Excess capacity assigned to grains in such a way that, if the excess were all exported, exports of the three classes of grains would be in the same proportions as in the 1972–73 crop years.

[b] Soybean equivalent of exported soybean meal included in exports of soybeans rather than domestic use.

[c] Harvested acreage of other crops minus acres double-cropped.

[d] Index numbers, 1971–73 crop years = 100. Includes the nine listed crops (but hay omitted from export index) and tobacco.

supply agriculture's growing needs for fertilizer, fuel, or other essential inputs will reduce agriculture's future capacity to produce. The small surplus projected for the standard situation could readily become a deficiency whose size depended on the extent of the energy shortage. Consumers would find less food on the market, prices would be higher, and agricultural exports would decline. Most such effects would be heightened if reduced energy supplies for agriculture happened to be combined with the high-demand situation; then food prices would reach highs not yet approached.

Similar comments would apply to substantial restraints on agriculture's production capacity for environmental reasons. Unless restraints took a general form such as across-the-board reduction in fertilizer use, environmental measures probably would be more selective than an energy shortage—effects would hit particular kinds of farming in particular areas especially hard. But inability to reach production levels projected for 1985 would have the types of consequences already outlined.

There are ways by which energy and environmental restraints can be partially countered by changes in agricultural production methods. In general, however, these would mitigate but not eliminate the effects described. New technology, yet to be developed, may be especially helpful on the environmental problem. But some popular notions about what can be done with organic farming or low-energy agriculture are merely romantic.

The remaining situation to be touched upon is the possibility of low demand, especially for export. It is disturbingly conceivable, for example, that the Arab states' oil monopoly will hold together and that consequent internal and foreign exchange problems will seriously reduce other countries' buying power for American farm products. Food aid for poor countries could turn out to be trivial either because it was not needed or because the American public declined to pay for it. The projections for the standard situation showed a little excess agricultural production capacity. If demand were materially lower than projected, surpluses would, of course, be larger. The long history of excess agricultural production capacity in the United States would be extended.

Applications, Meanings, Conclusions

The alternative agricultural situations discussed for 1985 could be much expanded, but it is time to turn to meanings we might draw from them for the future.

Forecasts

First, to what extent can any of the projections be regarded as forecasts? For forecasting,

Table 2. High-demand[a] projections for crops, 1985

Crop	Acres	Yield	Production	Domestic Use	Exports
	mil.		mil.	mil.	mil.
Corn, bu.	60.8	128	7,782		
Gr. sorghum, bu.	16.4	73	1,197		
Barley, bu.	11.0	58	638		
Oats, bu.	9.2	64	589		
Feed grains, tons	97.4	2.83	276	202	74[b]
Wheat, bu.	80.9	36	2,912	850	2,062[b]
Rice, cwt.	2.4	55.2	134	36	98[b]
All grains, tons	180.7		370	229	141[b]
Soybeans, bu.[c]	68.9	32	2,200	720	1,480
Cotton, bales	12.0	1.0	12	7.5	4.5
Hay, tons	57.0	2.33	133	133	—
All other[d]	31.4	—	—	—	—
Harvested Acreage	350.0	121[e]	—	—	188[e]

[a] Standard situation domestic demand, with feed grain and soybean utilization reduced to reflect higher prices, plus foreign demand high enough to raise real farm prices 30 percent and to take all output available for export; exports of three classes of grains proportionate to 1972–73 crop year averages.

[b] Available for export; exports of other commodities as in the standard situation.

[c] Soybean equivalent of exported soybean meal included in exports of soybeans rather than domestic use.

[d] Harvested acreage of other crops minus acres double-cropped.

[e] Index numbers, 1971–73 crop years = 100. Includes the nine listed crops (but hay omitted from export index) and tobacco.

we face the common problem in economics of being able to say something about what would happen within the system being analyzed if we knew what external forces were going to bear upon the system. But no one knows for sure how the policies of the European countries will affect their demand for American farm products a decade hence, how effectively poor countries will deal with food production and population problems now confronting them, whether protracted periods of poor weather will hit agriculture, or what will be the outcome of the Arab states' oil monopoly. It must be admitted, also, that high margins of error apply to predictions of what would happen within American agriculture even if external circumstances could be accurately foreseen.

Nevertheless, some outcomes seem more likely than others, and I should like to suggest the order of the subjective probabilities I attach to future developments. The standard situation, in which the circumstances of 1985 are largely determined by trends established prior to 1972, seems the most likely outcome. There is one important modification. The small size of the surplus projected for the standard situation in 1985, together with two recent food scares, one in 1966 and the other in the past two years, indicates that we can expect occasional shortages in the future. In this interpretation of what has been happening, the episode we are now in is a particularly severe instance of shortages at unpredictable intervals even though production is adequate or slightly excessive most of the time.

Very strong export demand on the order of that implied by the high-demand situation seems less probable for several reasons. The recent price experience should stimulate agricultural production in other developed countries and thus tend to hold down demand for American agricultural exports. Prospects that importing countries will substantially reduce protection for their domestic agricultures, never very bright, seem diminished by the recent high prices paid for imports. Unfavorable balances of payments also are likely to be a brake on agricultural imports of some countries.

Prospects that poor countries will need massive, continuing food aid from the United States are perhaps commonly overstated at present, but such prospects are by no means negligible. A further uncertainty is U. S. policy with regard to supplying food aid should the need be great. I want to mention this later in another connection. Here I shall only say, as a prediction and not as an expression of what ought to happen, that food aid is not likely to be a principal reason for huge agricultural exports on a continuing basis.

Higher energy costs than we once considered normal and some restrictions on agricultural production practices in the interest of environmental protection seem certain. If we manage our affairs reasonably well—and I would rather not have to show the plausibility of that assumption—agriculture's overall capacity to produce should not be much affected. Probably we shall have fertilizer bottlenecks for another two or three years, but they need not be enduring. Again, however, the probability of much less favorable outcomes is too high to ignore.

It is always difficult in one extreme circumstance to imagine that its opposite will eventually occur. I do not attach a high probability to the low-demand situation mentioned earlier, but the present tightness of supplies is no indication that it could not happen.

My treatment of the forecast question may strike noneconomists, at least, as evasive. But the important reason for forecasting is to make plans, private and public, for dealing with the future. Uncertainty about the future is an inescapable fact of life. We need to be prepared to deal with outcomes likely to occur, with special attention to those that could be especially unsatisfactory to us. It could be disastrous to make a specific forecast, to prepare to deal only with one outcome, and to find ourselves locked in when a very different outcome in fact develops.

Feeding ourselves

One of the surest conclusions in an uncertain world is that the United States can feed itself for a long time to come, probably indefinitely. One margin of safety is the current excess of food exports over food imports, an excess that could be used for our own consumption in dire circumstances. A second margin of safety is the ability to expand food production through technology and allocation of proportionately more resources to agriculture if necessary. A third margin of safety is the high level of consumption of animal products. Even if some disaster cut crop production capacity in half, the nutritional needs of our people could be met by shifting toward plant-derived foods and giving up a large portion of our animal-derived foods. The resulting diet would be most unsatisfactory to consumers; extremely high food prices or tight rationing would be necessary; and animal agriculture would be devastated. But the people could be fed.

Feeding poor countries

Feeding the poor countries of the world is an entirely different matter. The projections for the standard situation showed a small surplus of crop production in 1985. If this is added to the food aid included in projected exports, about 30 million tons of grain would be available for feeding poor countries. Thirty million tons is about 5 percent of total grain consumption of the less developed countries, including China, at the present time. If population grows at the recent rate, 30 million tons of grain, by 1985, would be absorbed by only one year's population growth in the poor countries.

The projected 30 million tons of grain would nonetheless be useful for dealing with individual, limited instances of food shortages around the world. In the past history of food aid by the United States, peak shipments were made in the crop years 1964 and 1965 when India was having particularly severe droughts. The grain and other farm commodities exported under government programs in those years amounted to the equivalent of 25 million tons of grain annually. The 30 million tons projected to be available for food aid in the standard situation would be roughly the same relative amount as at the peak of past programs.

More grain would be available for aid if a deliberate effort were made to raise prices as assumed for the high demand situation and to give all of production in excess of commercial demand to poor countries. There would be three sources of greater food aid in this situation than in the standard situation. First, increased output in response to high prices could be channeled into food for aid, principally grains. The kind of grain poor countries would accept would make some difference: maximum tonnage could be shipped if they would take large amounts of corn and sorghum, but probably they would want mostly wheat and rice. Second, high feed prices in the United States would reduce domestic consumption of animal products, freeing some land from feed crops for use, instead, for food aid. Third, high prices would reduce commercial exports and make more products available for aid shipments.

The tonnage of grain that could be available in the aid-induced, high-demand situation would vary with too many factors to consider in detail here. The projections suggest 100 million tons, about three-fourths in wheat, as a representative amount for 1985.[8] This would be four times as much food aid as we have ever given to date. One hundred million tons of grain could provide the food energy needs, though not all nutritional needs, of more than a quarter-billion people, greater than the U. S. population will be in 1985. Even so, the vast amount of grain would only delay famine if poor countries of the world ceased to expand their own food production but continued with the present high rates of population growth. One hundred million tons of grain would feed only three years' population growth in the less developed countries, including China, in the late 1980s.[9]

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[8] Possibly commercial export demand would be high

The food problem of the poor countries of the world is not hopeless, but food aid from the United States can play only a small part, albeit a valuable one, in working out a solution. One can suggest ways by which even more aid could be given than discussed here. Prospects are, however, that the costs, frustrations, and awareness of the ultimate inadequacy of food aid would result in far less aid than the 100 million tons of grain taken here to illustrate the potential. Costs to the American public would include (1) reduced domestic consumption of prized foods, principally animal products, (2) higher prices and larger food bills for consumers for the reduced amount of food actually purchased, (3) higher taxes, to pay for raw food materials sent abroad and for costs of simple processing, transportation, and handling, and (4) reduced foreign exchange earnings from commercial exports of farm products (foreign demand, in contrast to domestic demand, probably is elastic). The case for some food aid is strong enough to support an aid program; the more success agriculture has in expanding production, the easier it will be to have a large aid program; but prospective production capacity is not large enough to provide massive food aid without burdens on the public that the public probably will not choose to bear.

Research and development

The projections for 1985 highlight the importance of higher crop yields and improved conversion of feed into animal products as means of increasing agricultural output. Even the small surplus in the standard situation is dependent upon substantial further progress in improving production methods; a small defect in performance would convert the surplus into a deficiency. The projections for the high-demand situation show the need for greater production than usual trends would generate. These projections further show the difficulty of compensating for static technology by bringing more land into production.

In a broader sense, the ability of all countries, especially the poor countries, to deal with the rising need for food is crucially dependent on the expansion of scientific knowledge and its application through technology tailored to local conditions. Strong leadership of the United States in this effort, working in part through international agencies, probably has more potential for feeding the poor countries of the world than does aid in the form of food shipments.

Inadequacy of information about production potential

Anyone seeking to make estimates of how much the United States could increase its agricultural production under strong incentives for more output will be impressed by how little solid information is available on the subject. Surpluses characterized agriculture until two years ago; no systematic attention was given to what could be produced if need for expanded output were high. We do not know much about the economic barriers to cropping all the land considered available according to soil conservation criteria, nor do we know clearly the net addition to output to be realized by cropping that land. The interesting subject of double-cropping under strong production incentives remains highly speculative; we do not even have direct measures of how much of what is double-cropped at present. The feasibility of now-unused production practices at prices higher than customary price ranges is highly speculative.

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enough in 1985 to take all of the crops available for export at the high prices projected for the high-demand situation. In that event, no food would be available for aid unless aid was given priority over commercial sales. If demand (in the schedule sense) of foreign purchasers was no greater than in the standard situation and if commercial foreign purchasers responded to high prices by buying less grain and soybeans, about 100 million tons of grain would be available for food aid largely in the form of wheat exports. If recipients of aid would accept huge amounts of corn and sorghum grain, aid exports could be increased 25 percent or more.

[9] The tonnage of grains available for export in the standard situation is 48 percent of, and in the high demand situation 80 percent of, the "most probable" excess of production over domestic utilization projected for 1985 by Blakeslee, Heady, and Framingham [1]. The difference lies mainly in the latter's low projection of domestic utilization of grains for 1985 (less than actual utilization in the 1973 crop year). Projected exports in 1985 in the Blakeslee *et al.* study were only 53 percent of the potential amount because of lack of demand abroad; thus, they were roughly equal to the amount projected to be available in the standard situation of the study reported here.

Our knowledge is limited because in the past the prevailing opinion among farmers, in Congress, in agricultural supply firms, and among most researchers was that the information was not very practical for meeting here-and-now problems. This is a common misfortune afflicting applied research in general. It is clear now that we should have been doing more research in agriculture to show the full range of our production potential and in the energy field to determine how best to utilize energy sources that were not economically feasible while oil was so cheap. The public can well afford to pay for applied research that examines possibilities outside of immediately perceived needs and should not reserve only to pure or basic science the task of exploring questions of little current concern.

Price and market policies

Tonight's topic is full of implications concerning policies for farm income support, market stabilization, foreign agricultural trade, and the rate of output expansion. I have time for only a few comments. Willard Cochrane covered much of the ground.

One point that emerges is the vulnerability of our future food and agriculture system to instability. The most likely prospect is that agriculture will have a thin excess capacity much of the time, will experience continual variations in output because of weather, and will occasionally be shocked by exceptional surges of export demand. Prospects for stability are also poor if high demand causes constant strain on agriculture's production capacity. A leading policy need, therefore, is purposeful stabilization of market supplies and prices of leading crops—not stabilization of dollar-and-cent prices in a time of inflation, but holding particular agricultural prices near the paths required to obtain needed production. Given the size of export disturbances that may occur, stabilization stocks of the size ordinarily mentioned in the past decade may be incapable of giving protection when it is most needed. The United States perhaps should abandon the role of residual supplier on world markets, specify conditions under which it will not export freely, and through its own policies put pressure on other countries to carry stabilization stocks. Though income protection for farmers is not now a cause for much concern, the likelihood of significant surpluses, especially over intervals of a few years, is high enough to make limited income support at times of low prices a part of the total farm policy package.

It is possible that the nation would want to stimulate farm production more than the market would do in order, for example, to have massive amounts of food for poor countries or to more nearly assure an abundance of food for itself. Government policies could do this in various ways. One would be to reduce uncertainty, which now hinders investments needed to expand agricultural output; by long-term guarantees of favorable returns to producers of desired crops. Another way would be cheap credit for land development. My own appraisal of the future supply-demand balance does not suggest that such measures should be adopted. I do want to suggest that the public should shoulder a large part of the risk involved if it wants rapid expansion of agricultural capacity and that public assumption of the risk would be instrumental in obtaining expansion.

Summary

The leading conclusion, I think, is this: the most likely prospect for the next decade or so is that American agriculture will ordinarily have a little excess capacity to meet demands upon it at farm prices bearing their old relationships to other prices, but at unpredictable intervals temporary surges of export demand will turn the small excess into a deficit. We are now in such an episode, to be extended by a bad drought. From this outlook flows the prospect of an instability that will be particularly difficult to deal with. The future, always an enigma, is particularly uncertain now. Very strong export demand could cause exceptionally high food prices to continue despite a production increase induced by those high prices. Or inability to obtain sufficient fertilizer, fuel, or equipment might cause shortages even if demand were only normal. More than has usually been the case, we now need food and agricultural policies that take the interests of all segments of society into account and are highly flexible to deal with events as they unfold.

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INVITED ADDRESS

Domestic Food Costs*

LEO V. BLAKLEY

CONSUMERS and producers alike consider 1973 as a year of traumatic experiences. Apparently 1974 will be comparable, at least for many producers. Increasing general inflation and rapidly rising food prices in 1973 led first to consumer boycotts, then to meat price ceilings imposed at the retail but not the farm level. These actions led to disruption of the marketing system for meat and to drastic producer reactions involving drowning of baby chicks and slaughter of pregnant sows. Through all the changes, consumer food prices continued to climb and to lead the consumer price index upward.

Forecasts of the rate of increase in food prices were far under the actual rates. In mid-1973, for example, the U. S. Department of Agriculture was criticized for underestimating the rise in food prices which had occurred and probably would occur by year-end [2, p. 24]. The charge concerned projections of the average increase in domestic food prices during 1973 of first 3 percent (made in November, 1972), then 6 percent (February, 1973), then 9 percent (May, 1973). The actual change from January through December was 17.7 percent and averaged 14.5 percent higher in 1973 than in 1972.

Why did food costs increase so much beyond the expected levels? Some analysts have concluded that past economic models and parameters are no longer applicable and that revised parameters are needed for the new economic environment in which domestic consumers compete with foreign consumers for available supplies. Fox [3, p. 3] in an analysis of the food price forecasting problem concluded that no "U. S. agency has an adequate model of the world economy or even an adequate conceptual framework within which to discuss interactions among the food, agricultural and other sectors of the world economy."

The conclusion that all new models are needed does not appear warranted. Models involving domestic demand and the associated parameters remain valid and can be used in an analysis of conditions during the past two years as illustrated in the first section of the paper. There are new attributes of the domestic demand for food, however. In the second section of the paper, trends in the shares of incomes spent on food by different income groups, the shock of reversal of trends, and the impact of the food stamp program on meat consumption are considered. In subsequent sections, the relationship of marketing spreads to changes in farm and retail prices are analyzed, and the impact on consumer prices of increasing export demand with low reserve stocks are reviewed. For the latter some relationships and ranges of data admittedly are new.

Growth in Domestic Demand

Growth in the domestic demand for food and for specific food items has been one of the more predictable elements in our economy in recent years with population and income the two major demand shifters. Both have exhibited long-run growth and neither has shown large short-run departures from the projected growth.

Population in the United States has been increasing consistently. However, the annual increase in population has trended downward since 1961, declining from over 1.5 percent to less than 0.7 percent in 1973 [computed from 13, p. 3]. The change from year to year has been gradual even though the cumulative impact has been to reduce potential growth in food demand from this source by one-half.

Consumer incomes also have been increasing. Deflated per capita disposable personal income has shown no annual decrease since 1958, though a decrease was registered for the first half of 1974. The average increase in income for the years 1963 through 1973 averaged 2.97 percent.

The combined effect of changes in population and income, with an income elasticity of 0.27 as discussed later, indicates an increase in the demand for food of 1.5 percent in 1973. In contrast consumers were forced to reduce consumption by 1.5 percent. With annual real price increases of 12 to 14 percent, the implicit price elasticity for a quantity change of 3.0 percent is near —0.2.

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This is consistent with previous estimates and indicates no problem with projections of aggregate domestic demand in real terms. There may be problems, however, with the aggregate domestic demand relationships and with projections of inflation rates.

Share of Income Spent on Food

Much publicity has been given to the fact that American consumers now spend less than 16 percent of their income on food, a feat unmatched in most other countries of the world. The emphasis given to this statistic, however, may have done more to create a credibility gap for the public relations of agriculture than any other statistic reported. In no way can the majority of consumers identify with an expenditure pattern reflecting a percentage this low.

One problem with the statistic is the divisor—the amount of income. It is either the mean or the aggregate depending upon whether family or total food expenditures are considered, and either measure includes some very high incomes. For example, the mean family income reported for 1972 [7, p. 59] was $12,625 for a family size of 3.5 persons. At much lower levels were the median incomes of $11,116 for families and $9,225 for families and unrelated individuals.

Because families with different levels of income cannot afford to spend the same amount for food, median incomes were estimated for three groups which might have distinctly different diets and expenditure patterns. The three income groups selected were lower, middle, and upper thirds of the number of family households ranked by income. The level of income for each group was the estimated median income for that group.

Food costs are estimated by the U. S. Department of Agriculture [11] for three cost plans—liberal, moderate, and low. Data are reported for both individuals and families. For analysis of shares of income spent for food, a family of size four was selected. This four-person family consisted of a man and a women each 20–35 years of age, one boy 9 to 12 years, and one other child of either sex 6–9 years of age. Food costs for the four-person family as reported for the low, moderate, and liberal cost plans were obtained and expressed as percentages of the estimated median incomes. The costs and percentages of income spent would vary directly with the number of children and the presence of teenage children in the household.

Trends in shares

A four-person family in the middle one-third of the households in 1957 would have required expenditures of 24.0 percent of income to buy food under the low-cost plan, 32.4 percent for the moderate-cost plan, and 36.3 percent for the liberal plan (Table 1). A family in the third of the population with the lowest incomes would have required that more than one-half of the median income be spent for food under the low-cost plan, with moderate and liberal cost plans out of reach. In contrast to the situation for this large segment of the population, the national percentage of income spent on food was 20.7, almost the same as the liberal cost plan would have required for the third of households with the highest incomes.

Percentages of income spent on a given cost plan consistently declined from 1957 through 1972. The decreases were comparable for most groups, but the change from 21.4 percent to 12.9 percent for the upper income group's liberal plan seems less significant than the change from 56.9 percent to 34.2 percent for the lower income group's low-cost plan.

Comparison of the percentages of income spent on food under the three food cost plans by the middle third of the population indicates that consumers could have upgraded their diets at a constant percentage-of-income expenditure level. At the 26 percent level, for example, the middle income group could have moved gradually from the low-cost plan to the moderate-cost plan from 1957 to 1965 and from the moderate-cost plan to the liberal plan by 1969.

A sharp reversal in the downward trend in the percentage of income spent on food occurred in 1973. By the first quarter of 1974, preliminary estimates indicate that the middle income group had to adjust consumption in line with the expenditure share prevailing back in 1968. For the low income group, the share was exceeded only before 1967. Adjustments in consumption of these higher prices and larger shares of income required for food have been difficult.

Food stamp income supplements

The share of income spent on food and the indicated adjustments to 1973 conditions may be less severe for lower income families than indicated in Table 1. Many of these families have had the opportunity of participating in the food stamp program to help in the adjustment pro-

Table 1. Percentages of median family incomes of thirds of population ranked by size of income which are spent on three food-cost plans for four-person families, and percentages of U. S. disposable income spent on food, United States, 1957–1973

	Income Group					
	Lowest Third	Middle Third			Highest Third	
Year	Low-Cost	Low-Cost	Moderate-Cost	Liberal	Liberal	Share of Aggregate For Food
			Percent			
1957	54.7	24.0	32.4	36.3	20.6	20.7
1958	56.9	24.8	33.5	37.9	21.4	20.9
1959	53.1	23.0	31.0	35.1	20.2	20.3
1960	51.2	22.0	29.7	33.7	19.8	20.0
1961	50.8	21.7	29.2	33.1	19.3	19.8
1962	48.1	21.0	28.3	32.2	18.5	19.3
1963	46.0	20.2	27.3	31.0	17.5	18.9
1964	44.5	19.5	26.2	30.3	16.9	18.4
1965	42.8	18.9	25.3	29.4	16.4	18.1
1966	40.6	18.3	24.5	28.5	16.2	18.0
1967	37.4	17.1	22.9	26.7	15.3	17.2
1968	36.4	17.0	21.6	26.5	15.7	16.9
1969	35.4	16.4	21.0	25.7	14.6	16.4
1970	35.8	16.3	20.9	25.6	13.9	16.2
1971	35.4	16.0	20.5	25.1	13.5	15.7
1972	34.2	15.4	19.8	24.3	12.9	15.7
1973	35.2	15.8	20.4	24.9	13.5	15.8

Sources: Computed from [7 and 11].

cess. Since its beginning with authorized funds of $75 million in fiscal 1965, the program has expanded in geographical coverage, number of participants, and funds expended. Coupon values were at the $3.9 billion annual rate for 12.3 million participants in fiscal 1973 [8, p. 568].

The number of family units participating in the food stamp program on a year-around basis is not available. The 12.3 million participants may be equivalent to about 7.7 million families (about 11 percent) in the nation involved on a year-around basis. This estimate is consistent with equal weighting of full-time and quarter-time participating but may, in fact, underestimate the family numbers.

A family of four could qualify for a $112 stamp value in September 1973 if incomes and family characteristics made them eligible [14, p. 3]. The rates are higher in 1974. Above nominal income levels, participants have monthly purchase requirements of about 25 percent of monthly net income as income is defined for the program. At the average 1973 ratio of $1.22 bonus stamps value for each $1.00 purchase requirement, the increase in income would approximate 30 percent.

A 30 percent increase in effective income, whether through a cash grant or the food stamp program, will increase food consumption. Southworth [5] concluded that either program would be effective if both income elasticity and price elasticity were high. Moreover, substitution of goods with a high income elasticity for goods with a low (or negative) income elasticity would be expected as incomes increase.

Impacts on meat consumption

The downward trend in percentage of income spent on food and the upgrading of diets have generally supported an upward trend in meat consumption. The quantity of meat in the low-cost food plan included weekly consumption of only 11½ pounds. The quantity was 17¼ pounds per week for the moderate-cost plan, and 20¾ pounds per week for the liberal plan. The liberal plan, therefore, would permit a somewhat higher civilian meat consumption level than the all time high of 234.7 pounds per capita reached in 1971.

The major increase in meat consumption has been in beef consumption. If a series of annual demand schedules for beef were drawn using a price-elasticity of —0.6 and retail choice beef prices deflated by the Consumer Price Index for all items less food, most of the price-quantity combinations would be on those demand schedules. Three conclusions would be apparent. First, deflated prices were relatively stable at 83 to 91 cents per pound from 1963 through 1972, and consumption increased enough to take all that was produced. Second, the increase in per capita demand through 1970 tended to average about two pounds per year, but the increase was not consistent. Large increases occurred in 1966 and 1969, and in each case no change occurred in the following year. Third, increases in demand for beef in the 1970s are much greater than average, particularly in 1973, and appear to be supported by factors other than regular income growth.

The food stamp program obviously has been involved in the accelerated growth in demand for beef in the 1970s. Impacts of the program are hard to assess because of limited data, so the following estimates are crude at best. The low cost food plan for a family of four cost $170 per month in the fall of 1973. The stamps were valued at $112 and the bonus value at the average ratio would be $61.50. This bonus stamp value would be equivalent to 36 percent of the amount needed to purchase food. If the bonus permitted the family to reach the budgeted amount of meat (on a proportional basis), increased beef and veal consumption could be on the order of 760 million pounds or the equivalent of about 4 pounds per capita for the U.S. aggregate. Approached in a different way, meat consumption by participating families under similar total dollar subsidy assumptions would add 650 million pounds annually to beef consumption if the income elasticity were as high as 2.0 for participants.

The food stamp program, therefore, appears to have contributed from 3 to 4 pounds to the shift in the aggregate demand for beef during the 1970s. In terms of implicit changes associated with the demand schedule before this income effect, an equivalent decrease in quantity of 3.4 percent (primarily for non-participants) with a price elasticity of —0.6 would have been associated with higher prices of 5.7 percent. These estimates are consistent with the estimated 5 percent higher livestock prices which would result from Federal food subsidies of 3.3 billion as reported by Manderscheid [4, p. 3]. However, they fall short of a complete explanation of the apparent large shift in demand for beef in 1973 unless the short-run price elasticity is quite low.

Marketing Margins

Increasing retail food prices of such magnitude that consumers had to both spend more of their income for food and cut back on the quantity of meat consumption caused considerable anxiety if not distrust of the whole food marketing system. Non-farm firms have received much of the criticism since both marketing costs and farm-retail price spreads have increased.

Historical data suggest that marketing costs and spreads lag farm product prices in periods of changing demand and the accompanying deflationary or inflationary conditions. In 1921 the farm-retail price spread as a percentage of retail cost for the market basket was about 60. Since that time, the share for marketing spreads has made significant departures only three times. The first was during the depression of the early 1930s when farm-retail price spreads lagged farm prices in adjusting downward. The marketing spread share increased to 68 percent in 1932 before retreating to the 60 percent level in 1936. The second was during World War II when farm-retail price spreads lagged farm prices in adjusting upward. The marketing spread share had decreased to 47 percent by 1945 before returning to 60 percent in 1956, some time after the end of the Korean conflict. The third departure was 1973 when price spreads again lagged farm prices in adjusting to higher levels. The share for marketing spreads declined to 54 percent in 1973, but had returned to the 60 percent level by May 1974.

Inferences from demand equations

An analysis of the behavior of farm-retail price spreads to changing economic conditions can be approached in at least two ways. One way is to estimate elasticities or flexibilities for the retail and farm price levels and use the relationships among these estimates to make inferences about marketing spread behavior. Waugh [16, p. 25] used this approach to conclude that price spreads tended to be a constant percentage of the retail cost of the market basket prior to World War II and to approach a constant dollar spread after World War II.

The analysis was updated for the years 1963–73 using the same equations. The price elasticities and flexibilities for the 1963–73 period as shown in Table 2 were about the same as for the 1948–62 period. Apparently price spreads have continued to change less than the amount indicated as a constant percentage of the retail cost.

Table 2. Selected statistics[a] for regressions involving the indexes of per capita food consumption, per capita disposable personal income, and four measures of food prices and spreads, United States, 1963–1973

Dependent Variable and Equation Number	Constant (log)	Index of Consumption (log)	Index of Price (log)	Index of Income (log)	R^2
Consumer Price Index—Food (log)					
(1) Quantity Dependent	1.9828		−0.2611	0.2700	.949
			(3.61)	(5.95)	
(2) Price Dependent	5.0029	−2.3728		0.8740	.983
		(3.61)		(11.25)	
Market Basket—Retail Cost (log)					
(3) Price Dependent	6.8385	−3.3442		0.9275	.980
		(4.98)		(11.69)	
Market Basket—Farm Value (log)					
(4) Price Dependent	13.3836	−7.1957		1.5056	.974
		(6.91)		(12.24)	
Market Basket—Price Spread (log)					
(5) Price Dependent	2.3797	−0.7198		0.5334	.943
		(0.79)		(4.94)	
(6) Price Dependent	0.7459		0.3969[b]	0.2320	.958
			(1.95)	(1.95)	
(7) Price Dependent	1.0516		0.0819[c]	0.3958	.943
			(0.69)	(4.22)	

Sources: Computed from [12 and 13].

[a] Regression coefficients with t values in parentheses, and R^2 values.

[b] Independent variable is Market Basket Retail Cost.

[c] Independent variable is Market Basket Farm Value.

What is quite different in the updated results is the trend in income elasticity estimates. Waugh had concluded that farm prices had changed from more to less flexible than retail prices in response to changes in consumer incomes from pre-war to post-war periods. The results for 1963–73 do not support this conclusion. The income coefficient was greater for the farm value than for the retail cost, and both coefficients were similar to those obtained for the 1926–41 period (eq. 3 and 4). The income elasticity estimates in the quantity dependent equations were 0.270 for the CPI retail price series (eq. 1) and 0.195 for the farm value series (not shown). The latter is, however, lower than the 0.299 reported by Waugh for the pre-war period.

Direct estimates of marketing spread relationships

Coefficients for the regressions of the annual farm-retail price spreads on consumption, income, and two price series are also shown in Table 2. With per capita food consumption included in the equation, only the per capita disposable income variable was statistically significant (eq. 5). When the price spread was expressed as a function of the level of income and the retail cost of the market basket, both variables were important but statistically significant only at the 10 percent level (eq. 6). Substitution of the farm value for the retail cost resulted in statistical significance for the income variable but not for the price series (eq. 7). In other words, changes in the annual price spread in the regressions could be directly related to the retail cost but not to the farm value.

Some of the variability in prices and price spreads may be lost in the averaging process used in obtaining annual data. Therefore, quarterly rather than annual average data were used in subsequent equations. The equations were estimated both in logarithmic and index number (1967 = 100) form, but since the results were similar, only the latter are reported in Table 3. In addition, estimates for an earlier period, back to 1952 just after the end of the Korean Conflict, are also reported.

Per capita disposable personal income was consistently the most important variable associated with changes in the index of price spreads during the 1952–62 period. Income was also the most important variable during the 1963–73 period, though the coefficients were smaller. For

Table 3. Selected statistics[a] for regressions of index of quarterly market basket price spreads on indexes of per capita disposable personal income, retail costs, farm values, and selected lagged values, United States, 1952–62 and 1963–73

Period and Equation Number	Constant	Index of Income t	Index of Retail Cost t	Index of Retail Cost $t-1$	Index of Farm Value t	Index of Farm Value $t-1$	R^2
1952–62							
(1)	10.3966	0.7305 (19.47)	0.3164 (4.21)				.947
(2)	7.7193	0.7254 (19.71)	0.1264 (0.94)	0.2336 (1.7[illegible])			.950
(3)	24.0957	0.8576 (20.38)			0.0681 (1.65)		.928
(4)	19.0504	0.8928 (21.20)			−0.0804 (1.13)	0.1764 (2.48)	.938
1963–73							
(5)	44.8544	0.3081 (5.58)	0.2514 (2.80)				.947
(6)	29.7958	0.2153 (4.49)	−0.4253 (2.74)	0.9222 (4.92)			.967
(7)	55.5381	0.4480 (12.15)			0.0094 (0.23)		.937
(8)	51.3914	0.4125 (13.85)			−0.2061 (3.90)	0.2924 (5.14)	.962

Sources: Computed from data in [12] and [13].

[a] Regression coefficients, with t values in parentheses, and R^2 values.

both periods, coefficients for income were consistently lower when the price spread lagged one quarter was included as a variable.

One hypothesis concerning the behavior of the income effect is that the price spread reflects marketing costs of which labor is the largest cost item. Labor costs have been increasing—from 40.7 percent of the marketing bill in 1963 to 48.4 percent in 1972. With higher labor costs contributing to higher consumer incomes, and both series highly correlated because of general price level changes, the measured impact of rising consumer incomes on price spreads would reflect, partially at least, the influence of increasing labor costs on marketing costs and margins.

A second hypothesis concerning the income effect is that new services attached to raw farm products can be added more easily when relative farm prices are declining that when relative farm prices are increasing. With a price-inelastic retail demand schedule and with lower farm prices, it may be easier for the marketing firm to make a given profit from the sale of a product with more built-in services at the same retail price than to lower the retail price and sell a larger quantity. Adding the services and keeping retail price the same would require no adjustments in consumer expenditures and would be consistent with the fact that the income elasticity is much higher for marketing services than for the raw farm products. Based on the ratio of food items to all items less food in the Consumer Price Index, relative farm prices did decline during eight of the 10 years from 1963 through 1972. The ratio was generally less than 1.0 which favored the introduction of new marketing services.

In addition to the income effect, the regressions indicated that increases in retail costs were associated with net increases in price-spreads (eq. 1 and 5). The coefficients were intermediate between the upper limit required for a constant percentage of retail cost margin and the lower limit required for a constant dollar margin. When both the retail cost and the retail cost lagged one quarter were used in the same equation, the coefficients were statistically significant for the 1963–73 period (eq. 6) but not for the 1952–62 period (eq 2).

Changes in farm values did not appear to be closely related to changes in price spreads in the same quarter. The farm value coefficients were not statistically significant for either the 1952–62 or the 1963–73 period regressions (eq. 3 and 7). However, in both periods there was some evidence that lower farm values were associated with higher price spreads in the short-run but with lower price spreads in the longer run (eq. 4 and 8). This evidence is consistent with the conclusion that a short-run decrease in the farm value provides an opportunity to keep retail costs to consumer constant and possibly add additional services.

A similar problem of relating farm prices to price spreads exists for individual commodities such as fluid milk. Farm-retail price spreads for milk sold in half-gallon containers at stores in 48 federal order markets were regressed on price, population density, and population size in the order area for 1970 (computed from 10 and 15). When the farm (dealer pay) price of Class I milk was used as the price variable, the t value of the regression coefficient for price was not significant and the R^2 was only 0.14 for the equation. In contrast, when the retail price of milk was used as the price variable, the regression coefficient was 0.67, its t value was 12.86, and the R^2 for the equation was 0.80. The size of the coefficient indicated that price spreads were intermediate between a constant dollar and a constant percentage mark-up.

Export Demand Fluctuations

Factors affecting domestic food costs discussed thus far have been relatively stable. The domestic demand changes and their effects were small and generally predictable. The large and unpredictable changes came from the foreign demand sector. Hence, exports of agricultural products represent the focal point of the reasons for sharply increasing domestic food prices and the basis for the errors in projections of qualities demanded and the associated reserve stocks.

Wheat and feed grains are key commodities in the export situation. Both enter the food market directly as processed products and indirectly as inputs for livestock and livestock products. Wheat and feed grain prices during the 1960s were low and resting on floor prices in the developed countries of North America and Europe. As the policy of supporting agricultural prices in the United States changed from maintaining relatively high fixed levels for both internal and external prices to allowing price flexibility downward for external prices, the net export prices of commodities trended downward. The downward trend in dollar prices coupled with a decreasing value of the dollar caused lower absolute prices of wheat and feed grains in foreign countries. Relative prices of U. S. grains in the foreign countries were even lower because of general inflation in those countries. Consider, for example, relative grain prices in Japan. The net export prices of U. S. wheat at a Gulf Port location converted to yen, deflated for changes in the index of consumer prices in Japan, and expressed as indexes with 1967 = 100 are shown in Figure 1. From 1964 to 1972, this index declined 40 percent from 120 to 72. Accompanying this decline, exports of wheat and feed grains to Japan increased dramatically. Similar changes have occurred for relative prices and quantities exported to other countries.

The downward price trends for wheat and feed grains were reversed in the 1972–73 crop year with the impact of additional export demand. Adverse weather in the Soviet Union and income growth in Japan and Western Europe combined to create a large increase in export demand at a time when inventory stocks were dangerously low. Wheat and feed grain prices reached toward all time highs. Devaluation of the dollar accentuated the rise in domestic prices while moderating the real prices in foreign currencies. The 1973 deflated wheat prices in Japan had increased dramatically, but to only about the 1967 level.

Tweeten and Plaxico [6] estimated that about one-half the increase in agricultural exports in fiscal 1973 was transitory. If the same proportion applied for wheat and the four feed grains, the transitory increase in quantity demanded for exports would be equivalent to about 15 million metric tons. With supplies less domestic use up some 23.4 million metric tons, about one-half the transitory component could be fulfilled only by decreasing inventory stocks during the 1972–73 crop year.

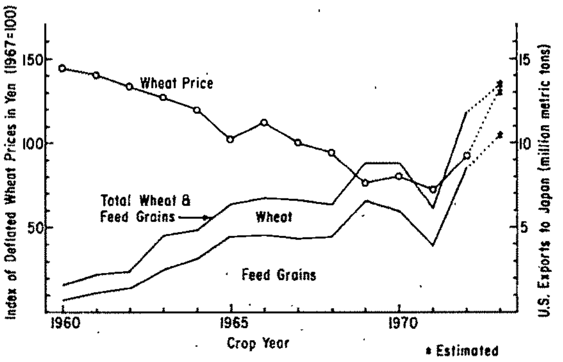

Figure 1. **U. S. exports of wheat and feed grains to Japan and Index of Export Prices of U. S. No. 1, HRW Wheat, ordinary protein, Gulf Port Location (yen per bushel deflated by the Index of Consumer Prices in Japan), 1960–1973**

The level of ending inventory stocks is of paramount importance in determining the extent of variability in agricultural commodity prices in response to transitory increases in export demand. Barr [1, p. 19] in a wheat study estimated that the season average farm price during the crop year changed very little when ending stocks were 600 million bushels or more. However, prices were highly sensitive to stock reductions below this level. Prices would rise above $4.00 per bushel for stocks less than 300 million bushels. Weldon [17, p. 5] reported a similar relationship for corn. Only a minor effect on corn prices occurred when ending stocks were 40 million tons or more, but the effect on prices was quite large for stock reductions below 30 million tons.

High exports with limited stocks are also associated with food prices increasing more rapidly than the general price level. From 1962 through 1972, there were two crop years in which exports of wheat and feed grains were far above the 11-year average [computed from 9, pp. 94 and 111]. The first was 1965–66 with exports of wheat and feed grains at 135 percent of average. The increase during 1966 in food prices was 4.7 index points, almost double the increase for all items in the Consumer Price Index. The second occurrence was the 1972–73 crop year with exports at 186 percent of the average. The increase in the CPI Food Index during the 12 months of 1973 was 17.9 points, more than double the increase for all items. For the other years, exports were near the average and the increase in the consumer price index for food was less than the increase for all items. Large export demand, therefore, can exert enough pressure to cause food prices to lead rather than lag upward changes in the general price level.

Short Term Outlook

Projections of domestic demand, export demand, and farm output indicates an approximate balance in a longer-run setting. Tweeten and Plaxico [5] estimated that little change in prices received relative to prices paid by farmers would be required for 1985 conditions, though the level of both price series could be substantially higher. In the intermediate term, however, relative prices are more uncertain.

The level of retail food prices in the immediate future will depend largely on inflation as reflected in the general price level, exports, and quantities produced. Double-digit inflation during the first half of 1974 combined with a high rate of expansion of the broad-based money supply (including large CD's) suggests at least an 8 percent annual increase in the price level during the second quarter of 1975 from year-earlier levels. In addition to the increasing general price level, above-average exports of grains are projected by the USDA which would cause food prices to continue leading the consumer price index upward.

Growth in real income could recover and reach a 2 percent annual rate of increase by the second quarter of 1975. With elasticities of 0.27 for income and —0.207 for price, food prices would be expected to increase 6.0 percent with no change in per capita consumption. Combined with expected inflation, the market basket retail value index would be expected to increase to at least 183 by May 1975. The increase would be even more than 14 percent if food output decreases, now expected, materialize. Any extra price increase (decrease) would be 2.4 percent for each 0.5 percent reduction (increase) in per capita consumption.

In the marketing sector, dollar values of farm-retail price spreads in the market basket are expected to increase for the following reasons: (1) the demand for marketing services attached to farm products will increase because of increasing consumer income, (2) some marketing costs are structured to increase directly as retail prices increase, and (3) elimination or reduction of the lag in marketing costs with a return toward the 60 percent marketing share level. For food chains, a return to the 60 percent share would permit an improvement in profits from the 0.6 percent of sales and the 6.1 percent return on stockholder equity reported for 1972. The profit rates had been about twice this high in the 1960s. If the index of retail cost of the market basket were 183 in the second quarter of 1975, a marketing share of 60 percent would imply an index of 180 for the index of farm-retail price spreads or an increase of 22 points from a year earlier. Only about half the change could be accounted for in the regressions in Table 3. In equation (5) the distribution of increases would be 5.2 index points from the increased income of consumers and 5.7 index points from the direct relationship of marketing spreads to retail costs.

A fourth reason for expecting increased marketing spreads is the potential change in cost structure for marketing firms to reflect much higher cost levels. Energy costs have escalated and labor costs appear poised for a large move upward to reestablished rising real wage rates.

Escalation of marketing costs would reflect a fundamental change requiring an equilibrium marketing share above 60 percent.

The estimated changes in the indexes of retail cost and marketing spreads for mid-1975 assume that farm output remains near the 1974 level. For this output the index of farm value would increase up to the level prevailing early in 1974. Though some adjustment in output could occur, the outlook is not bright for expansion sufficient to permit increased domestic consumption, large exports, and stock rebuilding during 1974. Given a longer adjustment period, downward pressure on farm prices is expected to develop as output increases above the 1974 level and as the equilibrium marketing share possibly moves above 60 percent.

Conclusions

The domestic demand for food can be analyzed with many of the traditional models and associated parameters. Growth in domestic demand comes primarily from population and income, each predictable within acceptable limits. The difference in annual growth rates between the optimistic (1.45 percent) and the less optimistic (0.8 percent) projections as estimated by Tweeten and Plaxico [5] is small.

Export demand is much less predictable, particularly for any specific year. When export demand is high at the same time that reserve stocks are low, severe upward pressure is placed on prices of raw agricultural commodities in both the export and domestic economies, and food prices tend to lead the Consumer Price Index upward.

Supplies and prices of agricultural commodities have permitted a rising standard of living for families with increasing incomes in the domestic economy. From 1957 through 1972 food costs as percentages of income were declining concurrently with constant upgrading of consumer diets. Rising retail prices in 1973, however, caused consumers to tighten food budgets back to the level prevailing more than five years earlier. However, the substitution of crop-based products for livestock and livestock products appears temporary.

The food stamp program has made large improvements in diets possible for the third of the population with the lowest incomes. The program apparently accounted for an increase in aggregate beef consumption of 3 to 4 pounds per capita.

Marketing spreads or retail-farm price spreads tend to lag large changes in food prices, going up as well as coming down. Price spreads have been related more closely to retail prices than to farm prices, and are highly correlated with consumer income. Both spreads and consumer incomes are correlated with higher price levels and with increasing labor costs of performing marketing services. In the short run, labor costs in particular appear poised for a quantum leap upward which would increase the cost of performing marketing services. The change could represent a change in structure such that a percentage margin higher than 60 percent would be required for a long-run equilibrium in the industry. In any event, higher food and food marketing costs appear likely in the next few months even though relative agricultural prices could stabilize or decline.

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INVITED ADDRESS

Some Economic Aspects of Agricultural Regulation and Stabilization*

JAMES P. HOUCK

NOT LONG AGO it seemed widely agreed that the policy problem facing U. S. agriculture contained two major parts. One was the income problem of poverty-ridden, non-commerical, small farmers and low-income rural people who depend on agricultural employment. The other part was the price and income problem of commercial farmers who supply the bulk of the nation's output of food and fiber. Perhaps the most prestigious statement of this two-part view was contained in the 1967 report of the National Advisory Commission on Food and Fiber [14].

There seemed to be virtually complete agreement that no amount of tinkering with commodity programs and prices could fix rural poverty problems in general or the income problems of too-small farmers in particular. Thus, the success or failure of traditional farm policy really hinged upon its ability to deal with commercial farm price, production, and income problems.

Most observers in the middle 1960s would have added that the success of commercial farm policy also should be gauged by how well the requirements of foreign markets and the needs of domestic consumers are met. The National Commission on Food and Fiber was unanimous in its support of a "market-oriented" pricing structure for most commodities affected by agricultural programs. But it was sharply divided on the issue of publicly-held commodity inventories for price or market stabilization purposes. It is fair to say that the Commission members, and most farm policy interests, wanted some stability as well as support for farm incomes and were willing to sanction farm price supports and direct payments to achieve it. The disagreement was between the majority who favored seeking market price stabilization via public inventory management and the minority who did not.

It is to the quest for market stability in agriculture that this paper is directed. In this discussion, stabilization as a policy goal will refer to conscious public efforts to decrease or regulate the fluctuation of prices, market volume, or income around long run, open market trends. Questions of net subsidization or net taxation of agriculture are not emphasized here. This may be something of an artificial distinction in any real policy context, but it is analytically helpful to adopt it. First, some discussion of market stabilization in its current policy context is presented. Then some rough empirical measures of the changes in stability are advanced. Finally, an analytical picture of market stabilization via reserve stocks and export regulation is developed.

Some Emerging Policy Issues

The recent upheavals in both domestic and foreign markets, the growing power of consumer interests, the dislocations caused by food price controls in 1971–73, and the continuing erosion of general farm political power provide impetus for yet another reconsideration of farm policy. No consensus comparable to that of the mid- and late-1960s is evident today. Now that government stocks are gone, acreage controls are dormant, and farm income is relatively high, one polar view is that finally the government can disentangle itself from much of its traditional farm program operations. Supporters of this view argue that standby programs involving target prices, price support loan rates, acreage allotments, etc., are still available under the Agricultural Act of 1973 if things should turn suddenly sour. But, hopefully, that will not occur and U. S. agriculture will have emerged from its historic disequilibrium. Efforts to stabilize prices and markets are viewed as largely unneeded or unworkable. Private industry and farmers will provide all necessary inventory functions under this view of generally unimpeded, open markets.[1]

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* Misc. Journal Series Paper 8830. Helpful comments came from M. Abel, W. Cochrane, R. Dahl, W. Peterson, M. Ryan, and W. Sundquist. They are innocent of residual error.

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[1] The recent speeches and public statements of Secretary of Agriculture Earl L. Butz most clearly enunciate this view. A good example is the Secretary's statement before the House Appropriations Committee, March 4, 1974 [5]. A vigorous exposition of the view that now

The opposing polar view, again simply stated, is that the backup programs of the 1973 Act are not sufficient in today's world. The activist proponents of this view generally concur that the core of the 1973 Act is acceptable, but they see two-way price or market stabilization and regulation as a prime policy objective for future agricultural programs. Some recent discussions and analyses of the current situation have strongly recommended various forms of stabilization measures. Grain reserves and buffer stocks are prominently featured [7, 23]. Support for various forms of export control and some renewed interest in international commodity arrangements also has emerged [25]. Legislation to provide for substantial publicly-held grain reserves and stand-by export controls recently has been introduced in Congress [19 and 24, p. iv].

Naturally the support and stabilization goals of these proposed programs are mingled together as always, but the emphasis on stability is strong. This is partly because the income support imperatives in current farm policy debates are much reduced. The fashioning of a clear dichotomy between rural poverty problems and commercial farm problems seems to have achieved this result.[2] Systematic efforts to control price fluctuation, both upward and downward, in major food and feed grains form the heart of new policy proposals. Stabilized grain and feed markets inside the U. S. would then contribute to stability in markets for livestock, meat, and related products. This stabilization linkage is increasingly important as specialization continues between cash crop production and livestock feeding. Ideas relating to the stability of world markets are less clear. Some proposals see U. S. policy, perhaps in concert with that of other nations, contributing to a major international stabilization effort.[3] Others visualize the achievement of domestic stability through the partial detachment of U. S. and world markets by means of export regulation or by more centralized management of exports.

There is something of a parallel between the farm policy issues and debates of the 1950s and the present situation. In the middle 1950s the central policy issue also involved the degree of public regulation of the agricultural sector. Then the main question involved the degree of support for farm prices and incomes; stability was a secondary issue. The free market view, then as now, was held most strongly by the Administration and its supporters. The diametrically-opposed viewpoint was reflected in proposals for stringent production and marketing controls advanced by some agricultural economists and farm organizations. Price and income protection for producers was the key objective. The essentials of that debate and its outcome are still familiar enough not to require recapitulation here.

The parallel comes in the continuing view of agriculture as a species of public utility.[4] The public utility argument in the 1950s was that agriculture was an industry too critical to be left to the misery of free markets in a world dominated by low elasticities, rapid technological advance, and oligopolistic surroundings.[5] The massive public investments in agricultural research and education buttressed this public util-

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is the time to abandon the old supply management commodity programs is provided by D. Gale Johnson [10]. However, Johnson does support a conscious grain reserve policy by the United States and other nations [25, pp. 105–119].

[2] I have never quite understood why the 1967 ERS-USDA study, *Parity Returns to Farmers,* never became a political bombshell, as I first predicted upon reading it [16]. True, it was not attractively packaged and none too widely circulated. (But neither was the first printing of *Lady Chatterley's Lover.*) This report, a workman-like job produced in response to a Congressional directive, showed that farmers who supplied over two-thirds of the nation's production in 1966 received average incomes well in excess of several parity benchmarks [16, p. 22].

[3] This effort might be separated from or combined with enlarged food reserves earmarked for emergency and disaster relief operations. Conceptually and operationally, market stabilization and food aid reserves should be kept separate from each other. Success in one area does not insure success in the other area. In any case, the goals of each are quite different [1].

[4] In the U. S., industries traditionally have come under strict government regulation as to rates and services rendered when they meet one or more criteria giving them status as public utilities. Public utilities typically are enterprises which provide (1) continuous, repeated services through more or less permanent connections between suppliers and users, or (2) transportation services for the public [17]. Regulation comes because at least one of several economic conditions prevail: (1) competition, as a practical matter, cannot long exist in the industry, (2) active competition can exist but the existing market structure does not produce competitive results, or (3) competitive results do occur or could occur, but for other policy considerations competitive results are unsatisfactory in one or more respects [11]. This latter situation and the continuous character of food purchase and consumption as a necessity seems to be the implicit keystone of a public utility view of the agricultural producing sector. Because many thousands of private firms are involved, it is a very special concept of public utility.

[5] Proponents of stringent supply control policies most strongly advanced this argument; see for example W. W. Cochrane's argument [6].

ity concept. Today the public utility view of agriculture emphasizes the role of public policy as a means to enhance stability of prices and markets in what appears to be an increasingly unstable world.[6]

Stability as a Policy Objective

The boiling economic environment of the recent two or three years has prompted many agricultural economists to refurbish their thinking on matters of economic instability and its consequences. Actually, the stabilization of agricultural prices and incomes has been part of the conceptual foundation of U. S. farm programs for a long time. It would be tedious to review here the history of stabilization as a farm policy goal. It would also be redundant to restate the well-known economic, biological, political, and environmental factors which generate instability in agricultural prices, production, and incomes. The strong elements of price and income support in U. S. policy generally have biased the construction and administration of farm programs toward the mitigation of downward fluctuations in prices and incomes. Upward fluctuations have been tolerated and generally welcomed.

Yet agricultural market instability has long been viewed as an economic problem to farmers and to the community at large. The supporting arguments rest on both efficiency and welfare grounds.[7] The efficiency argument against instability holds that price changes in many farm commodity markets are larger than necessary to guide (1) efficient allocation of productive resources in the shortrun, and (2) efficient allocation of purchases and expenditures by intermediate users and final consumers. Instability in quantities flowing through markets from period to period is argued to be unfavorable since the technical and economic efficiency of resources devoted to the transporting, storage, and processing of products is lowered.

On welfare grounds, the argument against instability suggests that the temporal uncertainty in the income flow to agricultural producers and rural areas poses several problems, particularly where production is specialized. These include problems of planning long-run investments and meeting regular debt repayment obligations. Widely-fluctuating income to producers may undermine rational planning of family living expenses and may increase the cash and asset base needed for economically-viable operations. In a wider context it may induce fluctuating incomes in sectors which service both the productive activities and living requirements of the affected primary sectors. Temporal uncertainty of prices and production creates similar but mirror-image problems to users. These problems involve difficulties in planning, budgeting, storage, and, possibly, financing consumption or utilization expenditures.

Each of these arguments against market instability is subject to debate in the professional literature. It is not the purpose of this paper to review that literature. However, there has been a recent revival of interest in the formal analysis of welfare gains and losses from price stabilization. Beginning mainly with papers by Waugh and Oi [15, 29] and continuing through more recent work by Massell, Turnovsky, and others, some general agreement seems to be emerging [3, 12, 13, 18, 22]. Using very simple abstract, but not implausible, economic models, recent writers find that there can be a generalized net welfare gain to society through price stabilization via buffer stocks. That is, the gainers from price stabilization conceptually could always compensate the losers. Where *both* demand and supply are subject to destabilizing factors, the gains to producers and consumers as separate groups may be either positive or negative, although positive overall. The distribution of gains and losses depends upon the source and size of the instability, demand and supply elasticities and the temporal nature of supply response. The distribution of welfare gains and losses between domestic and foreign individuals, where imports and exports are involved, is not always clear. However, the results do provide a modestly defensible general case on theoretical grounds for commodity price stabilization as economic policy.

A Brief Overview

Before looking at the instability question empirically, it may be helpful to view the most recent experience in its historical perspective. Figure 1 depicts the relative price and output

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[6] There is also evidence in the recent public statements of some political leaders that the public utility shoe is on the other foot; that it is now consumers who need to be continuously protected from the free market, not producers. At the moment, most of this oratory is directed at the food processing and retailing industry, not farmers. This suggests that the second of the three market conditions mentioned in footnote 4 is becoming relevant. The new public view of the international oil industry is a parallel development.

[7] The literature in this field is wide and deep. No attempt is made here at a systematic documentation.

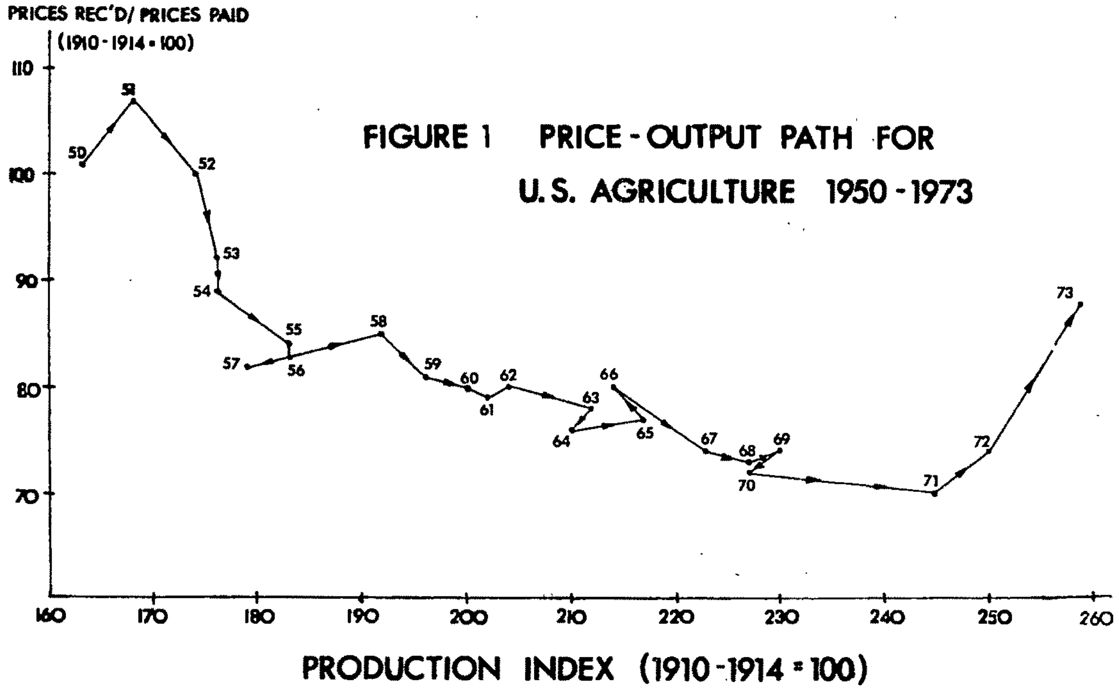

FIGURE 1 PRICE-OUTPUT PATH FOR U.S. AGRICULTURE 1950-1973

path of U. S. agriculture over the 1950–73 period. Figure 2 illustrates the behavior of output compared with domestic utilization, exports and stocks, in quantity terms.[8]

Following the boom period of the Korean War and until about 1971, the price-output picture in Figure 1 is consistent with the well-accepted model of long-run agricultural economic behavior in a developed nation, falling relative prices and persistently increasing output. In only five of the 20 years between 1951 and 1971 did relative farm prices increase. Aggregate production fell only four times. Had farm production not been modestly restrained and prices not been supported via the government programs of the 1950s, and especially the 1960s, the picture no doubt would have been different, though probably of the same general shape. The 1972–73 period displays agricultural price and production behavior that is unprecedented in the 24 year period here depicted.

The time series in Figure 2 illustrates why export and inventory behavior are linked closely to the most recent experiences. The rapid upward thrust in output, exports, and relative prices in the face of strong general price inflation seem to be at least partly the result of destabilizing influences such as currency realignments, bad weather in some areas, unexpectedly sharp maneuvers by Soviet traders, and changes in the habits of anchovies near Peru.

Economists are constantly seeking out and identifying turning points, crossroads, crises, and watersheds in public affairs. Recent events have intensified this tendency, and the visual impression of Figures 1 and 2 suggests that something important and fundamentally different has occurred. There are perhaps four main generalized views emerging:

(1) That the most recent portions of Figures 1 and 2 depict the beginning of a long fairly smooth upward trend in relative prices and output for agriculture.

(2) That nothing has really changed; 1972–73 was a unique experience not likely to be approached again by unfolding circumstances. The down trend in relative prices will resume and continue much as before.

(3) That an upward trend is beginning but the 1972–73 experience has strong new elements of non-trend instability in it. The emerging upward trend will not be as steep as the available data now sug-

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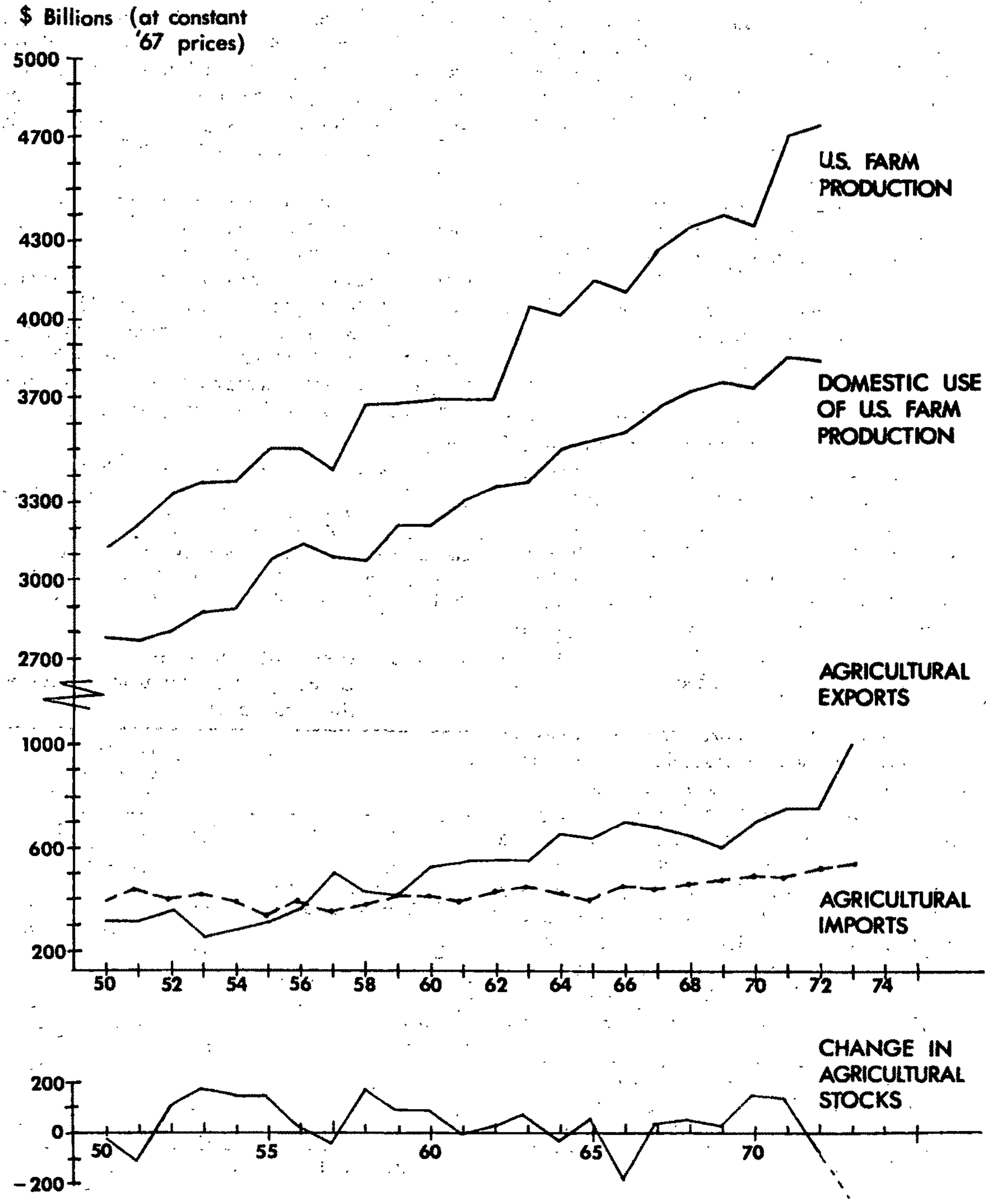
[8] The data upon which these figures and later analyses are based are from the standard USDA series [27, 28].

gest, but year-to-year fluctuation will be strong.

(4) That the traditional model of falling relative prices is still appropriate but the current experience shows an increasing propensity toward instability for a variety of reasons.

Among these alternative scenarios are to be found most current explanations of recent experience. Scenarios (1) and (2) suggest no new

FIGURE 2



need to develop stabilization policies.[9] On the other hand, scenarios (3) and (4) are consistent with proposals for new stabilization measures.

Instability Measured

The purpose of this section is to look at the empirical extent of recent instability in U. S. agriculture and to identify its source. What follows is not an elegant measurement and analytical exercise. It is a roughly approximate appraisal of how the current situation in agricultural prices, production, and income alters some measures of instability. In general it is much too early to tell how agriculture's stability is being affected by the rush of current events. In particular, most all the recent experience has been in one direction—upward.[10] The outline of future trends comparable in length to the 1951–72 experience is very murky. However, since serious policy proposals and legislation to regulate instability are moving forward, such an exercise may not be devoid of interest.

Price instability

The sharp upward thrust in relative prices in the 1972–73 period is starkly evident against the comparatively placid picture of the previous 15 years, Figure 1. In this recent period increases in relative crop prices have been larger than those for livestock, reflecting, of course, the tight world grain situation and low underlying elasticities of short run supply and demand. In addition, the lack of commercial and government inventories here and abroad prevented their normal buffering effect on crop price changes.

There are perhaps a dozen empirical tools for measuring variation or instability in economic time series. Each has advantages and disadvantages. The simple method employed here is based on year-to-year percentage changes in a series over a given time period. Three 10-year time periods are used for the purposes of this paper: 1951–60, 1961–70, 1964–73. The second and third periods overlap and can be used to illustrate the impact of the most recent experience on measured instability. Year-to-year percentage changes in various series were calculated for each of the three periods, expressed in absolute terms, and averaged for each 10-year period. Thus, the computed instability index indicates the average relative variability of the series considering both increases and decreases from the previous year.[11]

Table 1 contains values of this index for some agricultural price series. In the aggregate and for all crops and livestock, price instability seemed to decrease in the 1960s compared to the 1950s. The addition of 1971–73 increased the measured volatility of all agricultural prices substantially. The price changes now occurring and in prospect for the balance of 1974 probably will move these instability coefficients even higher.

There is some interesting behavior in these indexes of instability for individual commodity prices. Notice that individual prices of wheat, corn, soybeans, and cotton became more variable in the 1960s compared to the 1950s. This probably occurred as "market oriented" commodity programs were formulated and as direct income supplements were increasingly used to support farm income for producers of these key crops.

Table 1. Instability indexes for selected U. S. agricultural price series at the farm level

Item	Average Absolute Percentage Change from Previous Year		
	1951–60	1961–70	1964–73
		(percent)	
Prices received by farmers			
All farm products	5.6	3.1	7.9
All crops	3.7	3.4	7.7
All livestock	8.5	5.6	9.9
Prices paid by farmers[a]	2.7	1.9	3.6
Corn price	6.0	7.0	18.1
Wheat price	3.3	10.7	29.3
Soybean price	5.1	6.9	16.0
Cotton price	5.9	9.7	19.6
Cattle price	15.4	8.3	10.5
Hog price	14.8	11.1	21.1
Milk price	5.2	3.8	5.9

[a] All items used in production.

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[9] It could be argued that even if no change in inherent instability has occurred, new policies to deal with the same old problems are needed anyway.

[10] Figures for 1974, to the extent they can now be estimated, suggest some new downward experience in many agricultural prices.

[11] If a series has persistent trend in it, the index used here will be positive even if the trend is perfectly smooth. This is a disadvantage. To overcome the problem some measure of trend or a moving average must be introduced. This, in turn, is a drawback since the latter step requires either *a priori* knowledge or an arbitrary assumption about the nature of the underlying trend.

Production instability

Fluctuation in output is a combination of response to economic phenomenon and environmental effects beyond producers' control. Table 2 contains instability indexes reflecting relative year-to-year variability in various measures of U. S. agricultural output. No strong conclusions about changes in relative output variability can be drawn readily from the data in Table 2. The impact of the 1970 corn leaf blight and recovery from it in 1971 probably can be seen in the corn yield figures. The larger relative corn acreage changes in the 1960s can be traced to changes in voluntary program provisions affecting participation and diversion. Aside from corn, there is no compelling indication that U. S. farm production is becoming more unstable. This impression is strengthened when a full 25-year time series of actual production figures and overlapping instability indexes is examined.

Market instability

Have markets for U. S. agricultural products become more unstable? The data in Table 3 indicate that the relative stability of domestic utilization of farm commodities remained virtually unchanged since the 1950s. In fact domestic utilization fluctuates relatively less than does aggregate farm production. This naturally would be expected in a sophisticated economy with a well-developed marketing system and large export and import sectors.

Table 2. Instability indexes for selected U. S. agricultural production measures

Item	Average Absolute Percentage Change from Previous Year		
	1951–60	1961–70	1964–73
		(percent)	
Farm output	2.6	1.9	2.7
Livestock production	2.0	2.3	1.8
Crop production	3.0	2.9	4.2
Food grain production	15.4	6.8	7.9
Feed grain production	5.4	8.1	9.6
Corn acreage	1.5	6.0	6.1
Corn yield/acre	6.0	8.3	9.8
Corn production	5.3	9.4	11.3
Wheat acreage	9.4	7.5	7.9
Wheat yield/acre	11.6	4.1	4.3
Wheat production	17.6	7.2	8.1
Soybean acreage	7.1	6.0	7.2
Soybean yield/acre	4.9	4.7	4.1
Soybean production	11.7	8.1	8.8

Table 3. Instability indexes for domestic utilization and trade of agricultural products

Item	Average Absolute Percentage Change from Previous Year		
	1951–60	1961–70	1964–73
		(percent)	
Domestic utilization of U. S. farm commodities	1.4	1.6	1.5[a]
Agricultural exports[b]	15.9	6.8	10.1
Grain and feed exports[b]	22.0	12.3	16.8
Agricultural imports[b]	8.3	5.6	4.7

[a] 1963–72 average.
[b] Quantity indexes.

Many analysts pinpoint the foreign market, with all its political and economic uncertainties, as the major source of current destabilizing influences for U. S. agriculture. The modest secular growth in the importance of trade as an outlet for production and the recent shocks felt in this sector underscore this view.[12] Table 3 also shows instability indexes for quantity measures of all U. S. agricultural exports and imports plus grain and feed exports. The recent currency realignments, commodity shortages, and unexpected Soviet grain purchases, all acted to heighten export instability, especially in grains and feed. Still, the relative volatility of agricultural exports is lower now than in the 1950s. Of course the absolute amounts involved are much larger. Another year or two of comparable changes in agricultural trade, either up or down, likely will bring that instability index up to pre-1960 levels.

No such increasing stability is evident in the quantities of farm products being imported. Fluctuation in this sector is falling in relative terms.

Farm income instability

Farm income fluctuation is viewed as a leading economic problem associated with agricultural market instability. It has long been part of the conventional wisdom of agricultural economists that agricultural prices and net farm income move together; anything that changes farm prices will, in the short run, tend to change farm income in the same direction. There is no doubt that this linkage still operates. Farm price and income fluctuations are welded together even though direct payments under various government programs became a consistently-important source of farm income in the late 1950s and early 1960s.

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[12] In 1950–54 the export market took 9.1 percent of U. S. farm output; in 1968–72 it took 14.0 percent.

In the 1958–73 period more than 93 percent of the variation in net farm income *including* direct payments was directly associated with variation in prices received.[13] The similar relation between net income *excluding* payments and prices received was 96 percent. Thus, the flow of direct payments did not break or seriously weaken the traditional price-income link.[14]

The data in Table 4 illustrate how the stability of net realized farm income has changed in the three 10-year periods. The instability indexes for net income with and without direct payment are shown. As would be expected by anyone familiar with recent events, measured variability in farm income increases markedly when recent data are added.

As a sidelight, note the behavior of net farm income instability with and without payments over the three periods. Naturally we cannot know exactly how farm income would have behaved in the absence of payments and the programs under which they were made. But these data do suggest that, whatever else they did, the direct payments of the 1960s did not act to stabilize aggregate net farm income.[15] Any stabilizing influences which operated on farm income in the 1960s were not enhanced and may have been partly offset by direct payments. Furthermore, the correlation between changes in net farm income including payments and changes in net farm income excluding payments in the 1958–73 period exceeded 98 percent. Thus payments acted, in the aggregate, as a non-stabilizing layer on net farm income.[16]

Table 4. Instability indexes for net realized U. S. farm income, with and without direct government payments

Item	Average Absolute Percentage Change from Previous Year		
	1951–60	1961–70	1964–73
		(percent)	
Net farm income including direct payments	8.9	6.6	13.0
Net farm income excluding direct payments	9.0	5.5	11.7

Reserves, Export Controls, and Stabilization

Several serious proposals for market-stabilizing food and feed grain reserves coupled with export control authority are now being discussed. One of the strongest recent statements of such a scheme was written by W. W. Cochrane and published by the National Planning Association [7]. Senator Hubert Humphrey has introduced a Senate bill containing provisions broadly similar to the Cochrane proposals [19]. The purpose of this section is to link some simple analytical concepts with some of the instability ideas discussed in the previous section and, thereby, illustrate the central economics of this kind of proposal in a partial equilibrium setting. Welfare implications are not analyzed.

Panel (A) of Figure 3 illustrates the U. S. domestic market for the grains to be stabilized by the scheme. For simplicity, consider them either in the aggregate or in the context of a representative commodity. All demand and supply relationships shown in Figure 3 are expressed net of trend and other secular influences—the stabilization aspects are the focus here.

The U. S. domestic demand curve (DD) for the commodity is assumed to be a stable relation between price (P) and quantity (Q). The domestic supply is assumed fully inelastic in the short run and fluctuates randomly between S_1 and S_2. The net demand for private stocks is assumed to be part of DD and does not entirely wash out the effect of fluctuations in supplies. Other intricacies of private inventory holding are sidestepped here for convenience.

Panel (B) illustrates the world market from the U. S. viewpoint, with X on the horizontal axis

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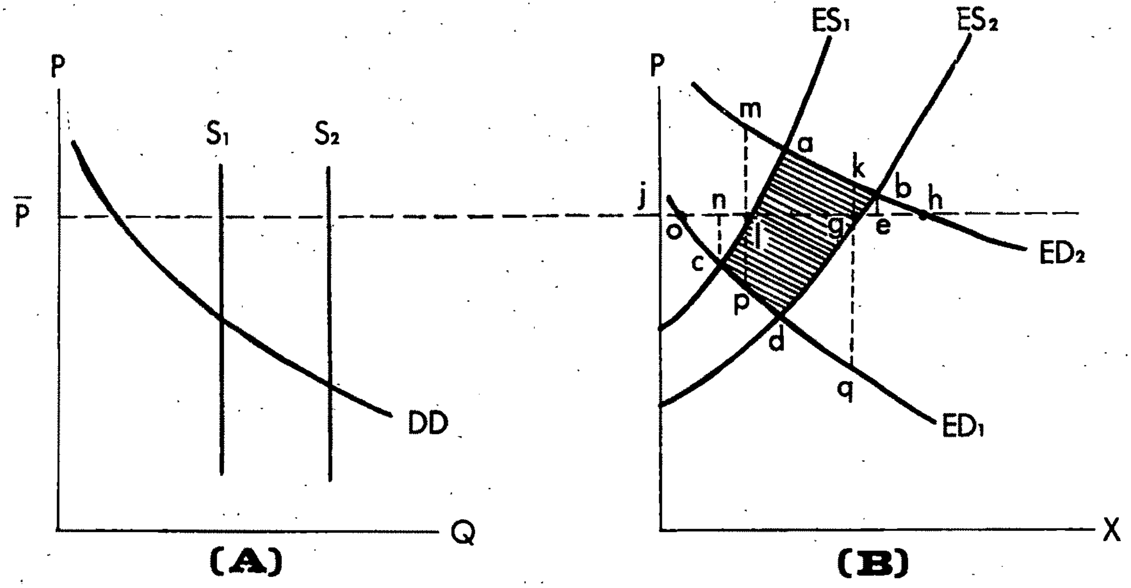
[13] The 1958–73 period was used so as to include the Soil Bank program which featured large direct payments to participating farmers.

[14] For some analyses on income instability and price instability as they jointly relate to stabilization policy, see [9, 21].

[15] This is consistent with conclusions drawn for an earlier period by Firch [8]. Many of the questions explored in his research are relevant to issues discussed in this paper. An updating of that work would be very appropriate now.

[16] Other measures of variation were computed over this period including standard deviations and coefficients of variation about both means and trend. All suggest that, in the aggregate, net farm income including payments was more unstable than income without payments.

FIGURE 3



indicating U. S. exports. The excess supply functions ES_1 and ES_2 are derived from S_1, S_2, and D in the usual way [4, Ch. 15]. For example, ES_1 is the horizontal difference between S_1 and D at each price. The world excess demand for U. S. grain fluctuates randomly and unpredictably between ED_1 and ED_2. This fluctuation is reasonably assumed to be larger than the supply-induced fluctuation in the U. S. excess supply function. It is caused by changes in the import demands of foreign buyers and in the export supplies of other foreign sellers. It is negatively-sloped to indicate that U. S. exports can influence world prices.

The shaded area in panel (B) enclosed by *abcd* includes all possible open market price and quantity outcomes, given the demand and supply fluctuations illustrated. Prices can vary from highs at *a* to lows at *d*. Exports can vary between those indicated at *b* to those indicated at *c*. (Throughout this discussion, only the price-quantity intersections indicated by lower case letters in Figure 3 will be mentioned. This convention will keep the diagram from becoming unnecessarily cluttered.) Free market price fluctuations inside the United States will be the same as those in the world market, and quantities demanded domestically will be reflected along DD at prices between those indicated at *a* and at *d*.

Now imagine that price is to be stabilized at $\overline{P}$ inside the United States. (This could easily be a band of acceptable prices, centered on $\overline{P}$; nothing material changes.) Following Cochrane, the stabilization mechanism is a combination of public reserve stock sales and acquisitions, export regulations, and export subsidies.[17] For the moment, an international grain reserve scheme is not assumed to operate. The price $\overline{P}$ is established so as to clear domestic and export markets at the average of S_1 and S_2 and the average of ED_1 and ED_2.[18] Consider the four corner cases depicted at *a*, *b*, *c*, and *d*. The issues relevant at these four points will cover the other non-extreme cases.

Strong demand—heavy supply (ED_2 and ES_2)

This case, at its most extreme, is shown at point *b*. With no intervention the market price will be higher than $\overline{P}$. If reserve stocks are sufficient, an amount equal to *gh* can be poured onto markets to push both world and domestic prices back to $\overline{P}$. Of this amount, *ge* moves to domestic buyers and *eh* is exported.

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[17] The Cochrane proposal involves a sequence of policy actions. First are stock disposals or acquisitions to defend the price goal. The second line of defense is export regulation or subsidy, the latter combined with production controls when several years of downward price pressures are foreseen. This sequential aspect is not emphasized here, although the analytical framework is adequate for it.

[18] The price level, $\overline{P}$, is a long-run trend value which can change from year to year. Its measurement would no doubt be a focal point of the policy process.

If reserve stocks are not sufficient, then controls would be placed on exports to reduce the domestic price to $\overline{P}$. With no buffer stocks on hand, exports would need to be constrained to *jg*. Domestic prices would hold at $\overline{P}$, but world prices would climb to *gk* dollars above $\overline{P}$. An export tax or some other fiscal device might be used to capture the *gk* windfall (or some part of it) accruing to private export license holders.

If reserve stocks were available in an amount less than *gh*, then export controls and stock disposals could be combined to maintain $\overline{P}$ in domestic markets. Stock sales could be made domestically allowing an equivalent relaxation of export controls; or export controls on private firms from domestic output could be maintained at *jg* and stock disposals made only for export. In either case, world price would be between *k* and *h* along ED_2, depending upon the volume of stock disposals actually made.

Strong demand—low supply (ED_2 and ES_1)

This condition results in maximum free market prices at point *a*, panel (B). With no buffer stocks on hand, export controls could be employed to hold domestic price at $\overline{P}$. This would involve export regulation equal to *jl*. Naturally such a constraint on exports in a strong demand situation will send world prices much higher than would otherwise occur. In this case, world prices would climb to point *m*, which is *lm* dollars per unit higher than $\overline{P}$. As before, this *lm* windfall would accrue to export license holders if no export levies were made.

If buffer stock sales can be made, world prices could be brought down along ED_2 toward point *h*. The latter point could be achieved and international price stability assured if a volume equal to *lh* could be released into the market. Depending upon the stock disposals, world prices would lie between *m* and *h* along ED_2.

Weak demand—low supply (ED_1 and ES_1)

The most extreme point of this situation is shown at point *c* in panel (B). With no action taken, free market prices will be *nc* dollars below $\overline{P}$. Reserve stocks of grain will not help in this situation. The authority must acquire stocks or subsidize exports. It might act to control grain production or farm marketing, but this would have its effect in later periods.

If the authority added to stocks, it might acquire *ol* units. This would bring the domestic and world price up to $\overline{P}$. If the authority could not add to its inventory or did not wish to do so, it could subsidize exports so that *jl* was exported. This action would hold domestic price at $\overline{P}$. If all of *jl* was placed on international commercial markets, world prices would fall *lp* dollars below $\overline{P}$. The export subsidy required would be *lp* dollars per unit sold abroad. Combinations of stock additions, export subsidies, and non-commercial disposals of production could move world prices between *o* and *p* along ED_1.

Weak demand—large supply (ED_1 and ES_2)

This is the case depicted at point *d* if no intervention is made. To bring prices up to $\overline{P}$ in both domestic and international markets, the authority would need to acquire *og* units for its reserve inventory. As with the previous case, the domestic price of $\overline{P}$ could be protected by export subsidy, non-commercial disposal, and (later) supply controls. Subsidizing *jg* units of exports to keep domestic price at $\overline{P}$ would result in a depression of world prices to point *q*. A subsidy of *gq* dollars would be needed on all commercial exports. World prices between *o* and *q* along ED_1 could be achieved depending upon the combination of stock additions, export subsidies, and non-commercial disposals undertaken.

Implications

There are many simplifications and shortcomings involved in this analytical sketch. Omitted here are considerations of storage costs, dynamic aspects of supply response in the United States and abroad, cooperation and retaliation by other producing and consuming nations, long-run trends in both demand and supply, wide or narrow zones of permitted price fluctuation around $\overline{P}$, and many others. This simplified model is designed to suggest a framework for further discussion. Some empirical evidence on the shape and position of the functions as well as the stock amounts required is beginning to accumulate in the literature [2, 20, 30].

A few central implications emerge. For example, when this kind of policy is followed, what is stabilized is the U. S. market. The foreign commercial market *may* be subject to increased instability of one kind or another. First, when prices are stabilized here and abroad solely by means of stock acquisitions and disposals, the *amounts* flowing to foreign markets tend to be destabilized compared to the free market operation within the shaded area *abcd*. Points *o* and *h* are examples. Second, when prices are stabilized internally solely by export controls or export subsidies, the export volume will remain inside the shaded area of free market operation, but world *prices* can escape from the shaded area as controls are applied and subsidies employed. Points *m* and *q* are examples.

Thus a major implication of domestic stability is a tendency toward international instability of markets either in quantities moving in trade or in international prices. This problem will not be felt directly in the United States by producers or consumers, but may have indirect effects on them. Along with storage and management costs, this issue is a critical consideration to be confronted by any stabilization effort. However, a judicious *combination* of reserve stock manipulations together with export regulation and subsidies can, in principle, offset this problem. Even with full domestic price stabilization at $\overline{P}$, the export market can be managed so as to insure that world prices and trade volumes remain inside the free market shaded area of *abcd*, Figure 3.

For instance, consider the first case discussed earlier, strong demand and heavy supply (ED_2 and ES_2). The regulation of exports made from domestic supplies to *jg* and reserve stock disposals of *ge* will hold internal U. S. prices at $\overline{P}$ and keep the international market at *b*, the latter point being the free market result. In the strong demand and low supply case (ED_2 and ES_1), export controls at *jl* and some stock disposals will hold $\overline{P}$ internally and keep world price and trade at point *a*. The results of similar operations in low price situations involve export subsidies and stock acquisitions to maintain $\overline{P}$ internally and keep the world market results in the shaded zone.

Further mitigation of these problems could be achieved by splitting the U. S. export market into "regular customers" and "others." The regular customers might be guaranteed "usual" volumes or a pro-rata share of exports when large stock acquisitions are being made or when export controls are being applied. Similarly, when export controls are applied, regular customers could be guaranteed buying prices around $\overline{P}$. Transshipment problems as well as foregone foreign exchange earnings then would have to be dealt with.

On the other hand, problems with other suppliers would exist when export subsidies are being employed or when sales from the reserve stock are being made onto world markets. These are relatively familiar problems and need not be reiterated here. They certainly will not go away under a new stabilization policy, and from time to time could get worse.

If the U. S. stabilization scheme is internationalized into a coordinated reserve stock policy including major exporters and importers, some of the external problems of a U. S. stabilization policy would be internalized by the participating group. The overall effects would then be easier to achieve if the scheme is workable. But that is another paper.

Concluding Comments

Market instability is likely to be a target of agricultural regulation in coming years. The current interest of some policy-makers and analysts in stabilization policy supports this view. The export market is the source of much current and potential instability in agriculture. A carefully-framed and skillfully-operated program of reserve stock acquisition and disposal together with export regulation and subsidy could effectively stabilize domestic prices of major U. S. grains. Such a program could be operated to avoid destabilizing grain markets outside the United States.

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Session 11

NATIONAL POPULATION DISTRIBUTION POLICIES AND PROGRAMS

CHAIRMAN: J. DEAN JANSMA, PENNSYLVANIA STATE UNIVERSITY

Balanced Population and Economic Growth: Policy and Research*

W. B. BACK

THE NATIONAL DIALOGUE underway on the population distribution aspects of rural development is mainly talk about the problems or concerns believed to be due to high rates of rural-to-urban migration. It is not a discussion about specific policy options and consequences. There does not now exist, nor has there ever existed, either a national consensus upon, or a commitment to, an explicit national policy[1] on the geographical distribution of the population. Nor is there a clearly defined operational set of national policy options which could be the basis of debate, political support, national commitment, policy and program development and action.[2] Although balanced growth or population distribution policy logically should be a component of or a strategy within national growth policy, I will proceed on the premise that this component relating to the geographical distribution of people and economic activity can be a separate and identifiable national policy.

The unsatisfactory state of population distribution, balanced growth, or rural development policy reflects in part either an inadequate or an inaccessible knowledge base. I do not believe the thrusts of ongoing rural development research at the state universities or elsewhere provide promise of producing the needed knowledge base prerequisite to development of a sound national rural development policy. What appears needed are arrangements for committing a significant portion of the research resources in rural development to projects in direct support of national policy-making processes affecting the geographical distribution of population and economic activity.

Concepts, Conceived Problems, and Actions

Achievement of "rural-urban balance," or "balanced growth," has meaning as a policy goal only if one believes the undesired elements in our situations are causally related to how people are distributed geographically. Advocates of rural-urban balance presuppose such a causal relationship. The actual situations deemed to be undesirable may be specific in subject-matter to economics, social science, or political science. Other perceptions of problem situations encompass two or more of these subject-matter disciplines. The independent and overlapping subject-matter areas of the perceived undesired situations are portrayed in the first column of Table 1. The second and third columns of the table contain examples and selected references, respectively. Periods in recent history (1955–1960, 1961–1968, and 1969 to present) exhibit differing emphases upon the economic, social, and political dimensions of the underlying bases for actions taken. The following brief review of programs

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[1] I define a policy, especially a national policy, to be a widespread public commitment to mutually consistent principles, objectives, and strategies that establish the framework for administrative behavior in conducting designated aspects of the public's business. Prerequisite to policy, as defined, is a policy making or planning process that encompasses the determination (or clarification) of any priorities or objectives, delineation of options and consequences, proposing actions to be taken, and acquisition of public consent and of any needed legal authority.

[2] This proposition is consistent with a conclusion of the Advisory Commission on Intergovernmental Relations expressed as follows: ". . . there is a specific need for immediate establishment of a national policy for guiding the location and character of future urbanization, involving Federal, State, and local governments in collaboration with the private sector of the national economy" [1, p. 129].

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Table 1. A classification of some undesired situations believed to be related to migration trends

Subject-Matter Category of Problem Situations	Examples	Selected Sources
Economic	Suboptimal spatial distribution of economic activity	Wilbur R. Thompson [21]
	Unemployment or underemployment of labor and fixed capital, and associated low incomes of rural people, in the wake of technological advances in agriculture	Development of Agriculture's Human Resources [6]
Social	Increasing crime, congestion and pollution in major urban centers, declining standards of living in rural areas	Orville Freeman [7, 8], Task Force on Rural Development [19]
	Declining influence of agrarian-based values and institutions	American Country Life Association [2]
Political	Reduction in rural influence in Congressional composition and policy making	Charles M. Hardin [9] Ross Talbot [20]
	Political uncertainty and instability associated with periodic redistricting	Charles M. Hardin [9]
Interrelated economic and social	Discrimination as an impediment to rural economic and social progress	James G. Maddox [12]
	Increasing rural and urban poverty [Inequality of opportunity]	Commission on Rural Poverty [18]
Interrelated economic and political	Declining power of farm sector leaders to influence Federal programs and policies affecting farm incomes	James Bonnen [3]
	Changing distributive impacts of agricultural research and education with increasing industrialization of agriculture	Agri-business Accountability Project Group [10]
Interrelated social and political	Limited capability of local governments to cope with increasing crime, congestion, pollution, and other growth-related social problems	Symposium on Communities of Tomorrow [21]
	Local political and governmental impediments to desired social adjustment in rural areas	Lustig and Reiner [11]
Interrelated economic, social, and political	Threat to national domestic tranquility, security (including national defense), stability and prosperity	Section 901(a) Agricultural Act of 1970

and activity in rural development is divided by those periods.[3]

Economics and action (1955–1960)

Location theory provided economists with standards for gauging the efficiency of any geographical allocations of economic activity and people. A prevalent interpretation of that theory, at least through the 1950s, was that people ought to locate where the jobs are and that migration basically is the response to economic and technological changes. Although migration from rural areas was massive, it was thought that growing unemployment and underemployment in rural areas reflected not enough rural-to-urban migration. Support to this thesis was added by urban oriented economists who postulated continuing existence of substantial private economies of increased concentration of economic activity in the major urban centers [21].

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[3] Prior to 1955, many concerns about the geographical distribution of people have been related to undesired situations believed related to this distribution, or to a belief that a different distribution would solve a problem. Horace Greeley promoted the first successful land colony in the early 1870s as a haven for the destitute (Greeley, Colorado). About the turn of the 20th Century, the Salvation Army began colonizing the countryside to provide homes for the destitute in the cities. Henry Ford advocated decentralization of industrial plants in order to provide underemployed farmers with opportunities for part-time industrial jobs. Governor Franklin D. Roosevelt's Emergency Relief Administration helped many people move out of urban areas. His Presidential inaugural address of March 4, 1933, referred to the overbalance of population in industrial centers and the need to engage in redistribution of population on a national scale in order to provide better use of our land. This idea was implemented by a provision in the National Industrial Recovery legislation of 1933 making $25 million available for "redistribution of the overbalance of population in industrial centers." Under this authority, a Division of Subsistence Homesteads was established in the Department of Interior, which later was transferred to the Resettlement Administration, which in turn was transferred to USDA in 1937 and became a component of the Farm Security Administration. Rural-urban balance was recognized as a desirable goal in planning for the location of defense industries during World War II. The mobilization planners of the 1950s stressed industrial dispersion as a way of lessening nuclear attack. Many other similar examples are contained in notes developed by the Agricultural Historians within ERS.

Many economists and public officials did not accept these views about how people or jobs should be distributed geographically. Economists within USDA who led in the initiation of a pilot rural development program in 1955 were not strict adherents to this location theory.[4] The pilot rural development program represented an attempt to create more nonfarm jobs in the rural areas.

The pilot rural development program could be considered a failure primarily because the idea of creating jobs in rural areas was never put to serious test by the kind and magnitude of the action taken. The thrust of the action was technical, educational, and planning assistance led by the Extension Service. This effort never approached the annual budget levels devoted to R&D and extension education for labor-reducing farm technology, which was postulated to be one important source of the problem. However, what seemed to have been tested by this experience, and found wanting, was the sufficiency of technical or educational assistance for achieving rural development.

Social action thrusts (1961–1968)

The Democratic Administrations in the 1960s retained a rural job creation emphasis to rural development, but added major sociological dimensions, especially with the "war on poverty." New major federal program thrusts to deal with income, employment, and social problems in depressed rural areas occurred outside USDA—Area Redevelopment Administration and subsequently EDA and the Title V Regional Commissions in the Department of Commerce, Appalachian Regional Development Commission, Small Business Administration, and the Office of Economic Opportunity, in particular.

Within USDA, there occurred shifts in agency leadership from Extension to Farmers Home Administration and the Soil Conservation Service, consistent with the stress on action programs rather than education. A Rural Community Development Service was created to perform coordination and outreach functions. The scope of this agency's authority was sharply curtailed following Congressional objections to its existence.

The scattering of federal activities intended to enhance development of rural areas were not unified or coordinated through or by a national policy. The situation was similar to that described by Monihan for the Office of Economic Opportunity programs. He said these OEO programs never did, nor could, add up to a national policy, as was intended [14]. One lesson here is that national policy is not a necessary prerequisite to program development and action. Major federal programs targeted at minority interests can and do arise purely from the kind of perceived problems as expressed in Table 1. In a pluralistic democratic society it is easier to obtain majority tolerance for "micro-programs" targeted at minority interests, than to achieve majority consensus on a strategic national policy. In fact public pressures for such "micro-programs" may impede progress in achieving majority consensus on strategic national policies.

Secretary of Agriculture Orville Freeman apparently recognized the rural development policy void late in his tenure of office, as evidenced by his speeches calling for development of a national policy of rural-urban balance [7, 8]. His rationale for reducing the rural to urban migration stressed the urban crime, congestion, and pollution caused by the increasing geographic concentration of the population (Table 1). Possibly implied in this kind of expression was the virtue of country living as an alternative. A similar line of reasoning was used later by the Task Force on Rural Development [19]. However, the American Country Life Association has been the leading open advocate of the virtues of traditional rural values and institutions [2].

Secretary Freeman's campaign for a national rural-urban balance policy, the "war on poverty," and the war in Vietnam were competing for attention and support late in the Johnson Administration. The federal-wide symposium on communities of tomorrow late in 1967 was the "high-water mark" of Secretary Freeman's efforts [22]. The report of the National Advisory Commission on Rural Poverty in 1967 was the peak of the national dialogue on poverty [18]. The Vietnam war reduced the national priority on both rural development and poverty.

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[4] I refer to Don Paarlberg and True Morse. President Eisenhower, in a special message on January 11, 1954, asked that particular attention be given to the problems peculiar to farmers with low incomes. Don Paarlberg led a department-wide study in response to that request. A report on the study entitled "Development of Agriculture's Human Resources" [5] was released about a year later. The Under Secretary, True Morse, was assigned the responsibility for departmental leadership of the pilot rural development program.

Political goals and action (1969 to present)

The more political concerns about rural-to-urban migration have been continuous and highly specific justifications for rural development. Political scientists [9, 20] and some rural congressmen or political leaders have spoken out. Congressional debate on redistricting to implement the "one-man, one vote" ruling of the Supreme Court is one example.[5] The political voices are now becoming more audible, especially since the availability of published results of the Census of 1970. Although the nation gained in population by about 13 percent in the 1960s, more than half of the nonmetro counties lost population in the decade.

Although recent history is familiar, it needs some discussion to complete this story. Two "political themes" are relevant—the Congressional actions on rural-urban balance or rural development through enactment of more federal categorical programs, and the Administration efforts to create and administer policies according to principles of "New Federalism," which seeks to assign more responsibility to state and local governments. The resulting political confrontation between the Administration and the Congress dominated the significant aspects of efforts to achieve a national rural development policy since 1969.

Title IX of the Agricultural Act of 1970 on Rural Development became law despite the objections of the Administration. Most of this Title related to the requirement for submission of periodic reports on subject-matter in rural development of limited interest to a "New-Federalist." However, it contained an expression of a Congressional commitment to rural-urban balance. This commitment could be viewed as an announced Congressional position or posture rather than an expression of policy. In the language of the Act, ". . . the highest priority must be given to the revitalization and development of rural areas."

The Rural Development Act of 1972 further exemplified Congressional interest in population distribution. Initially, there was a Senate version developed by a subcommittee on Rural Development chaired by Senator Humphrey, which stressed development of credit institutions commensurate with a conceived "credit-gap" impeding rural development. A House version of the Rural Development Act then followed, as an alternative to both the Senate bill and the Administration's proposed Department of Community Development. Both the House and the Senate versions incorporated legislative proposals by USDA agencies over a period of several years, some of which had the approval of the Administration, but most did not. There followed Senate and House enactment of separate bills, development of Conferees report, and final Congressional enactment. The bill was signed by President Nixon on August 30, 1972, two months before the Presidential election.

Many provisions of the Act appeared to be a legislative commitment to a leftover 1968 USDA agenda. Section 603 was designed to make USDA the lead federal agency in rural development, an aspiration of the Department administration in the 1960s. Section 118 duplicates existing authorities of other Federal agencies (EDA, HUD, SBA, etc.). The same type of duplication exists for Section 104 community facility loans, and Sections 102 and 121 business loans. Some of the added authorities for conservation and environmental quality were new, but marginal in significance to rural development. Also, a question could be raised as to what Title V authorizes that could not have been done under existing authorities for research and extension.

The Administration did have "New Federalism" alternatives to the Congressional actions in rural development. The thrust of the "New Federalism" was to return power from the federal government back to state and local governments, a campaign pledge in 1968. Under New Federalism, federal involvement in administration of rural development activity would be minimal, and state local, and private involvement would be at a maximum. A major Administration proposal was revenue sharing for rural development. Rural development revenue sharing would allow nearly full administration of federal financing of rural development activity by state and local governments. This proposal was considered, but rejected by the Congress.

Following defeat of the rural revenue sharing proposal, the Administration proposed credit-sharing as a "New Federalist" way of Federal financial backing of rural development [13]. Under this proposal most loans would be made by private institutions, but guaranteed by the federal government. Loan guarantee levels would be allocated by formula to states, and states would direct use of the loans in accordance with state rural development plans—an administrative procedure similar to that proposed for revenue sharing. This proposal could have influenced some provisions in the Rural Development Act relating to guaranteed loans, but not the intent of the Act with respect to administrative arrangements.

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[5] Supreme Court decisions occurred in 1964 in connection with cases involving apportionment of Congressional seats and seats in both houses of State Legislatures [8, p. 1092].

Following passage of the Act, a confrontation between the Administration and the Congress centered on plans and proposed guidelines for administering the newly authorized industrial development and community facility loan and grant programs in accordance with the principles of New Federalism. Guidelines were developed which would have delegated authority to state officials to review and approve loan applications. Grant funds would have been administered in a corresponding way. The Congress intervened to veto this procedure with the Curtis Amendment to the RD Act contained in the Agriculture and Consumer Protection Act of 1973, itself a "veto-proof" piece of legislation. This kept loan approval authority at the Federal level. The Administration amended the proposed guidelines to encourage FmHA responsiveness to state and local rural development plans and strategies when making loans and grants, a very weak New Federalist posture.

Knowledge and Research for Policy Making

The above review of rural development since 1955 indicates that political criteria have been a major basis for policy proposals and actions in rural development, especially in events associated with the Rural Development Act of 1972. There is no alternative to a political process in policy making. But as experience reveals, a political process alone is not sufficient to assure success. The political aspects of policy making have to do mainly with administrative and public processes or activity required to establish public policy. A central feature of these processes is deciding upon priorities among conflicting values or objectives, and how benefits and burdens will be distributed among various segments of society. The major substance of national policy, once established, is criteria or principles of administrative and public conduct, which involves ethics, social and economic values, institutional and legal instruments, and related knowledge. Achievement of the desired national policy of population distribution would not be assured by addition of a reliable knowledge base, but it would provide policy officials with means for assessing consequences of alternative policy options.

In the beginning I pointed a finger at the research establishment for contributing to the unsatisfactory state of affairs.[6] Now I will try to back up that viewpoint.

The nature and magnitude of knowledge impediments to development of national rural development (or balanced growth) policy are extremely difficult to describe and quantify. One approach is to describe the informational requirements for a national model in economic and demographic geography which could generate reliable estimates of future short- and long-run consequences of any plausible policy action. Although actual development of a national rural development model may not be a fully attainable goal due to a dearth of knowledge relevant for identifying the variables, parameters, and functional relations, the thought processes that would be involved in such model building could be appropriate means of identifying knowledge deficiencies to rural development policy making.

A logical beginning in a modeling process might be to ask questions about the validity of the presupposed causal relationships implicit in Table 1. Such questions relate to the structure of a model, or of one's perception of the total situation. Does the geographical distribution of people really matter, or would the "undesired situations" have emerged and prevailed regardless of the degree of concentration of people in space? Why did the present geographical distribution emerge? Which of the possible geographical distributions of people matter and which do not? Does the social, economic, and moral strength of the nation depend upon maintaining a significant proportion of the population within a traditionally rural culture? Or, alternatively, does such a culture impede social and economic progress? Researchers have not provided the knowledge base for answering these and related questions. An adequate knowledge assessment might reveal a degree of public ignorance extending to the highest administrative levels in government. However, as Don Paarlberg has said, "They [researchers] could at least provide a measure of our present ignorance, which would itself be a helpful thing" [17, p. 8].[7]

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[6] One reviewer indicated that a more fundamental knowledge issue than portrayed in this paper relates to how to achieve the national goals in population distribution, once they are articulated or selected. The viewpoint that an articulation and selection of the goals should precede identification of relevant issues for research is inconsistent with my fundamental thesis that the adequacy of policy making, including goal selection, is in part a function of the state of knowledge. There are deep-seated issues in philosophy relating to this subject—issues that should be addressed in separate papers, if it is worthwhile to pursue them. In my view of policy making in a pluralistic society, including goal making as a component thereof, no public official or national commission can select acceptable goals independently of the political processes or independently of prior knowledge.

Another major subject-matter area for questions would be location economics. Which industries have been newly locating in rural areas, and which have been leaving those areas, and why? What have been, or likely will (or could) be, the future economic functions of rural areas? To what extent, and by what specific methods, can public intervention modify what otherwise would be the geographical distribution of future economic activity? What would be the public costs of alternative degrees of modification achievable? What is the likely economic future of industries now locating in rural areas? What are the economically-feasible (viable) geographical locational patterns of private industries, public and private facilities and services, and residences for differing sizes of geographical areas and populations? How are these patterns changing, or likely to change in the future? Some of these questions are factual, but the thrust is futuristic. Social scientists should be held accountable for addressing such questions and for providing factual or theoretical knowledge bases for estimating answers.

The responsiveness of people to various economic and other stimuli is another major subject the national policy model builder would explore. We have hardly scratched the surface in providing quantitative explanations of migration patterns, especially regarding the relative contribution of economic, cultural, and environmental stimuli. Many of the policy options would change the geography of economic and other stimuli, and estimated responsiveness of people to those stimuli must also be incorporated in the analytical framework.

These subject-matter areas and questions are mere examples to portray the nature of needed knowledge for establishing a national rural development or balanced growth policy.

There is a significant philosophical issue which may impede progress in building the knowledge base for policy making purposes. Many researchers have been taught a scientific method which not only requires empirical testing of propositions (hypotheses), but makes completion of such testing the terminal point in the research. This method tends to limit the research perspective to the facts. The sometimes expressed purpose of prediction is cast in terms of *ceteris paribus* conditions corresponding to those under which the hypotheses were tested. The strict adherents to this philosophy would focus the research exclusively on the past, and in terms of facts and subject-matter of the discipline, rather than policy issues. Too frequently, the policy content of research occurs as "implications" at the end of a research report, as if they were logical consequences of the research findings. These policy expressions seldom are useful. An understanding of the past is relevant in policy making only to the extent it has utility in revealing the future consequences of present (and future) decisions or actions. Analysis of the future cannot include immediate empirical testing of hypotheses—future data or facts occur as consequences after policy decisions have been made and action taken. Any testing of hypotheses, developed as policy or program options, must occur as evaluations of experience arising from the policy or program decisions previously made. Thus the stages in this kind of research may be separated by considerable lapses in time and carried out as separate operations by different individuals. Research analysis for policy making has been variously labelled operations research, systems analysis, policy science, and futures research.[8]

Another impediment to progress in answering questions of relevance in national policy making is the limited opportunities or financial support to research workers for engaging in that type of research. States may consider the practical worth of research on state or local problems to be higher than the worth of state supported research on national problems. Other impediments would relate to available techniques and costs of acquiring different kinds of facts for use in research analyses.

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[7] A principal issue underlying the questions in this paragraph relates to problem identification. Is there justification for a unique public effort to slow down or stem the rural-to-urban migration by creating nonfarm jobs in rural areas? If the answer is no, then there is no justification for any unique public programs under the banner of rural development; rather, any existing social problems in rural areas should be considered in the context of national, rather than rural, problems.

[8] Operations research with use of sophisticated computer models is not new to agricultural economists, but application of such techniques for tracing future consequences of alternative national rural development policy options would be new.

A Characterization of SAES Rural Development Research

A brief review of some current SAES rural development research projects was made for the purpose of ascertaining how closely the ongoing research is related to the knowledge needs of national policy makers. A print-out from CRIS listed about 400 such projects; this was reduced to 250 through eliminating those listed for physical or biological science departments, home economics, and agricultural education. Projects in sociology were included if the content related closely to objectives of ongoing economic research. Because one cannot adequately analyze research from merely reviewing titles and objectives of approved projects, this assessment may be considered more of an expression of a hypothesis than a statement of conclusions about the research.[9]

A summary of the projects is presented in Table 2. The major characteristics of the research are as follows:

—About one-third occur as contributions to regional projects.[10]

—More than a fourth of the research is directed to public facility and service issues.

—Sixteen percent is focused upon population mobility and distribution, the primary basis for the national dialogue and activity in rural development.

—Fourteen percent is devoted to rural development planning and potentials.

—Seven percent is devoted to industrial issues.

The strong emphasis on regional research may have resulted from the generally low priority given to rural development research within the states. A project contributing to an undertaking by several states is easier for a researcher to defend than would be the same project portrayed as an independent state undertaking.

The apparent priority given to community facilities and services by research workers may reflect only a recent public awareness of the problems of rural communities in attaining or maintaining adequate local public services, especially in sparsely populated areas, or in rural areas with declining populations. Perhaps research workers failed to gain public support for this area of research until the problems became acute.

Notably absent in the individual state project statements was any reference to specific state or local officials or leaders in rural development as the audience for the research reports. The projects with emphasis on rural development planning apparently were not specifically oriented to the needs of particular planners. In general the state or locally oriented research was directed to an abstract audience of rural or public leaders, if an audience was indicated at all. A number of hypotheses could explain this situation, especially (a) a widespread belief that state or local leadership or institutions are inadequate for administering effective rural development planning and activity, (b) lack of interest of the researchers in any involvement in State or local rural development activity, (c) inability to interest public officials in research proposals, or (d) unwillingness to orient the research to the specific decision problems of public officials. In support of the first hypothesis, some aspects of some regional research reflected the need for local institution-building for effectiveness in providing local public services. Also, some of the independent state projects in community facilities and services also reflect a felt need for some local institution-building.

Overall, the search for evidence of ongoing research capable of removing the knowledge impediments to development of national policy on rural development or balanced growth was in vain. The same conclusion could have been drawn from a review of ongoing rural development research for any period during the past two decades. This conclusion also is consistent with the principal thesis in Jim Copp's recent presidential address at an annual meeting of the Rural Socio-

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[9] The current SAES research reviewed is not the sole basis for this assessment. For example, I am unable to exclude biases arising from about two decades of both observation and personal research activity on rural economic problems other than those associated directly with commercial agriculture. Also, as an analyst with frequent needs for knowledge inputs to policy analysis, I tend to evaluate automatically the utility of any observed ongoing research, including especially that within ERS. I excluded the ERS rural development research from the CRIS inventory partly because of my familiarity with it and partly to allow a separate characterization of SAES research. Afterward I decided little, if anything, would be gained by adding an ERS component to the research inventory. Although a significant portion of ERS rural development research is broadly oriented to policy and to service activity, it has not focused upon the specific knowledge impediments to development of national balanced growth or rural development policy.

[10] The generality or diversity of issues incorporated in regional projects rendered impractical a sub-classification similar to that developed for the independent state projects.

Table 2. A summary of some current state rural development research projects

Principal Issues Under Investigation	State Projects	
	Number	Percent of Total
Local Public Facilities and Services[a]	[67]	[26.8]
Contributions to Regional Projects	26	10.4
Financing (e.g., property taxes)	16	6.4
Alternative delivery systems	9	3.6
Cost Analysis	6	2.4
Other	10	4.0
Poverty and Income Distribution	[41]	[16.4]
Contributions to Regional Projects	17	6.8
Description and Causes	14	5.6
Potential for Individual Adjustments	6	2.4
Policy or Program Evaluation	4	1.6
Natural Resource Use and Development	[41]	[16.4]
Contributions to Regional Projects	12	4.8
Recreation Enterprises or Impacts	14	5.6
Land Use	7	2.8
Water Resource Development	3	1.2
Other	5	2.0
Population Change and Distribution	[40]	[16.0]
Contributions to Regional Projects	21	8.4
Demographic Processes or Trends	9	3.6
Analyses and/or Projection	10	4.0
Rural Development Planning and Potentials	[35]	[14.0]
Contributions to Regional Projects	6	2.4
Delineation and/or Viability of Areas	9	3.6
Assessment of Growth Potentials	10	4:0
Planning Processes and Data	6	2.4
Other	4	1.6
Industry Analysis and Industrialization	18	7.2
Labor or Manpower	8	3.2
Total	250	100.0
Contributions to Regional Projects	82	32.8
Independent State Projects	168	67.2

Source: Printout from CRIS, 11 March 1974. It is recognized that much SAES research in rural development may not be included in CRIS.

[a] Includes health services, which are primarily delivered by the private sector.

logical Society—apparently Rural Sociologists, too, have made only minor contributions to advancement in the kinds of knowledge needed by public policy makers [5].

A principal factor in the absence of a planned effort in research to contribute to national rural development policy making, for both economists and sociologists, could be an absence of public support for such research. The proposals to follow presuppose that the research needed will require justification in terms of it being a direct and essential component of the national policy making process.

Some Proposals

Numerous unproductive efforts have been made within the past two decades to reorient radically the subject-matter content and procedures in economic research. This paper is not intended to be another effort of that kind. I believe it may be possible to start a process that eventually will fulfill the knowledge needs of national rural development policy officials by initiating a modest, but carefully monitored, research effort. The following possibilities depict some tentative ideas on how this may be done:

1. The Secretary of Agriculture could utilize the authority contained in Section 603 of the Rural Development Act of 1972 to earmark a portion of the Federal rural development research funds for direct support of national policy making. These earmarked funds could be supplemented by use of small portions of funds appropriated for

administrative expense in operating rural development programs.

2. The Secretary could approve use of the earmarked funds for rural development policy research on the basis of merit of specific proposals (bids) from SAES research workers, regional groups of SAES research workers, or private individuals of groups. If a proposal is to assist national program managers, it should include comments from those officials.
3. Federal policy or program officials could be provided the opportunity to review and comment on all regional rural development research proposals containing national policy or program evaluation objectives prior to final approval.

A minimum of about $500,000 annually would be required to implement the first two proposals adequately. Administration could be within the Office of the Secretary, by a board consisting of the Assistant Secretary for Rural Development; the Assistant Secretary for Conservation, Research and Education; and, the Director of Agricultural Economics. Alternatively, the administration could be by a national board made up of representatives of the universities, state governments, and private organizations, as well as USDA policy officials.

In addition to the research needs for policy making discussed earlier, some candidates for contracts might include significant aspects of the following:

1. Rural-urban variations in quantities and qualities of various community facilities and services, and reasons therefor.
2. Cost-effectiveness of various types of public incentives to influence the location of industries in rural areas.
3. Effects of the geographical incidence of federal expenditures for defense, transportation, housing, etc., on population distribution and geography of private sector economic activity.
4. Potential capabilities of state and local governments for financing and managing processes in rural development.
5. Nature, scope, and effectiveness of state and local plans for rural development—actual and potential.
6. Capabilities and limitations of private sector financial institutions serving rural areas for supporting major capital investments for rural development.

The third proposal would provide the opportunity to federal policy or program officials to have some direct influence on the content of regional rural development research, in addition to that approved for contracts.

In many respects these proposals are not new. Contracts now are made to private groups and university staff for national policy related research. The new or different aspects are (1) the commitment of resources in advance and on a regular annual basis, and (2) the focus on making knowledge development an integral part of the continuing policy making process in rural development. Hopefully, success with this type of effort, overtime, would result in significant increases in the policy relevance of other rural development research.

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Public Goods in Rural Areas: Problems, Policies, and Population

PAUL W. BARKLEY

THE PUBLIC GOOD is the bane and the blessing of the working economist. It is baneful because it does not comfortably fit the rules of allocation or efficiency and it demands that allegiance be paid to equity—a very difficult aspect in economic policy and analysis. The public good is also a blessing for the working economist since it provides a true frontier in theory, research and policy—a frontier that should be as productive to this and the next generation of economists as the marginal analysis proved to be for Marshall and his followers.

Public goods are goods characterized by nonexclusivity, huge indivisibilities, externalities in production and/or consumption and zero or near zero marginal costs.[1] They are not new to economists or to economic reasoning but have only recently come into their own as important research themes. Adam Smith spent a great deal of time discussing features of economic society that would have to be provided through nonmarket mechanisms. His public goods centered on transport, defense and the 18th century versions of consumer protection—the laws of contract. Later economists expanded Smith's ideas to include an infrastructure of public goods that could be related to social needs or economic needs. Neither Smith nor his successors provided analysis; the public good was simply produced and made available.

Regardless of how precise the definition or analysis of public goods becomes, such goods still suffer when subjected to economic analysis. Because of their public nature, no ordinary markets exist for these goods. Consumers reflect demands through a balloting process but their is no mechanism through which consumers can reveal temporary preferences or rapid changes in preferences. Thus, no relative price ratios appear to allocate resources between public and private goods or among collections of public goods. The economist's role is weakened by this lack of information. Certainly questions about public goods are economic for they ask about the allocation of scarce means among alternative and competing ends. But there is not enough information to use in critically analyzing the mix, the intensity, or the timing associated with providing these kinds of goods.

This problem and many problems ancillary to it are particularly severe in the nation's rural areas where some public goods are free for the asking, others are extremely expensive, and where our present data systems make analysis extremely difficult.[2] In spite of difficulties, the problems have acquired urgency (1) since rural people are noticing their relative disadvantage in some important classes of public goods, (2) since rising income levels increase the marginal propensity to consume public goods but diminish the marginal propensity to consume private goods, and (3) since the interest in public goods in rural areas arises not only from those already in such areas but also from those who wish to move to rural communities in an effort to escape the travail of the metropolis.

This paper must be regarded as speculative in many of its aspects. Too little is known about public goods for economists to make positive statements, and results of researches pertaining

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[1] These are not mutually exclusive categories. Indivisibilities in production, for example, drive marginal costs to zero for many types of goods. Similarly, the nonexclusion feature causes (or allows) externalities in consumption to arise. Every public good does not have each of these characteristics and some have more of each characteristic than others. Thus, public goods can be pure or impure.

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[2] The problem of public goods in rural areas scarcely needs documentation. It has been shown that rural health care services are inferior, rural schools do not turn out as many National Merit Scholars, and rural communities must depend upon the inefficient and often dangerous septic tank systems rather than more advanced and safe means of sewage disposal. It has been amply demonstrated that even though the collection of services available in rural regions is limited, the per capita cost of providing such services is high—considerably higher than in metro areas.

In the state of Washington, the eight counties with populations below 10,000 made average per capita public expenditures (operating expenses only) of $330 in 1970. Counties with populations between 10,000 and 50,000 spent an average of $278 per capita, and counties with more than 50,000 population averaged $240 per capita. This argument finds its logical extreme in Boise County, Idaho, where annual public expenditures of $1902 are made by each of its 1,779 persons [8].

to one area (either geographic or subject matter) do not easily transfer to other areas. Speculative thinking is needed before adequate theory or adequate research related to public services in rural areas can be conducted. As the title implies, this paper divides into sections dealing with problems, policies, and population.

Public Goods Problems

Public goods problems stem from three fundamental conditions in economics: there can be too few, there can be too many, or those that are present can be of an undesirable or unneeded quality. Understandably, most economists attempting to solve puzzles surrounding public goods have taken one of these problems as central and have built analyses around it. When public goods have been scarce, economists have modeled improved distribution over space, improved transport networks and increased output. When the public good has been surplus, the recommendation has been consolidation and when quality has been the problem, production functions have been redesigned to incorporate changes in input mixes and changes in rates of substitution among inputs.

While such researches are important and lead to useful clues regarding improvement of delivery systems and alleviation of stress, the more fundamental problems of efficiency in allocation, equity and equilibrium have often been ignored.

Public goods and efficiency in allocation

The presence of public goods in the production functions of private goods and in the consumption functions of consumers gives public goods a unique role with respect to allocative efficiency. Transportation networks, educational systems, flood control, and public health programs all have complementary or supplementary relationships to other factors. Rural areas cannot match urban areas in their ability to use public goods to enhance the productivity of private factors. Much research has been conducted in an attempt to isolate the strategic variables that might either bring rural collections up to some minimum acceptable standard or compensate factor owners for public good inadequacies.[3] In spite of conscious efforts to improve enhancement capabilities in rural areas, the use of many productive resources remains more efficient in metropolitan areas.

The interesting questions of allocative efficiency are not those of how public goods affect private production functions. Of interest are the efficiencies or lack of efficiencies in production of the goods themselves. It is known that physicians are scarce and that hospitals are not fireproofed in rural areas. It is not known how "medical care" is produced in the physician's office nor do we know how inputs are combined inside hospital walls.[4] It is of utmost importance that the intricacies of producing health care, appendectomies, justice, safe housing, and sewage treatment be understood if we are to design more effective delivery systems.

Once these productive relationships are understood, the role of the producing firm must be analyzed. The firm is central to nearly all of economics and tangential to that part which it does not dominate. However, the role of the firm in producing public goods is only a shadow of the role envisaged for the firm by Ricardo, Marshall, (especially) Knight, Chamberlin and Stigler. For them, the firm absorbed risk, and the task of the entrepreneur was to gather and combine factors in a fashion that maximized profits or at least minimized losses.

Public goods are often produced by firm-like entities, but these surrogate firms perform only the weak allocative function; they do not and perhaps cannot absorb risk. The voter-consumers who give public good producing firms sanction are the same persons who must absorb losses engendered by errors in choicemaking or outright failures. This is quite in contrast to private production of private goods. The problem becomes more severe in rural areas where the public good producing firm is small, unspecialized, and cannot hide behind the veil of bureaucracy. Limiting the role of the firm is serious since it invalidates a major strength of microeconomics. Without this engine of analysis, the study of efficiency in allocation is seriously impaired.

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[3] The term "strategic variable" was used in classes taught by Emery N. Castle at Oregon State University in the mid-1950s. A strategic variable is one that has the capacity to alter significantly the position or slope of a production function. Thus, irrigation water is a strategic variable for much of the West, and acquiring a new Hilton Hotel may be strategic for a city. Recent conversations with Castle reveal that he has not used the term in his published works nor has he continued to use it in the classroom. Other terms—most of them derived from institutional economics—have conveyed the message. The term "strategic variable" may have value in communicating notions of the economist to noneconomist clientele groups. The term will be used again in the closing section of this paper.

[4] This is quite in contrast to the production of other kinds of goods and services. Before sorghum grains enjoyed widespread adoption in the Plains, the production processes for these grains were well understood, and before chemicals were widely used in agricultural production, their effects on individual production functions were fairly well understood.

In spite of these weaknesses, the economist must be prepared to say something about efficiencies and inefficiencies surrounding the delivery of public goods in rural areas. Many things are being said about the factors (resources) necessary to produce public goods but without prices, without clearly revealed preferences, and without adequate measures of output, existing and accessible theory scarcely matches the producing institution so economists are reduced to description, weak analysis, and vainglorious recommendation.

Public Goods and Equity

The conflict between equity and efficiency has torn economists since the emergence of the New Welfare Economics. The efficiency dictates of the marginal conditions depend upon given and constant distributions of income, given tastes, and given preferences. But movements toward equity invariably require transfers of income that disrupt any Pareto optimality whether that optimality is an observed condition or a stated goal. In a word, equity is untidy.

In spite of its untidyness, the equity issue must be joined because many arguments central to rural community development themes and much discussion about population redistribution stems from or is tangential to the problem of giving rural residents equal or improved access to public goods such as health care, sanitation, nursing homes, libraries, justice, protection, and flood control. Data series pertaining to these kinds of services consistently show rural areas to be disadvantaged.

Most empirical work on equity in access to public goods has centered on education. The collective results of many studies are almost unanimous in their suggestion that rural schools are inferior to urban schools. To correct this imbalance, economists and educators alike have tried to make rural schools more like their urban counterparts. This prescription is curious in view of the current outcry that deplores behavioral characteristics of the urban public school student and his teachers—narcotics, alcohol, sexual abuse, and indifference toward learning. However, studies show that rural schools do not deliver quality education, so change must ensue to insure equity among recipients of public education.

The problem of equity in access has also been researched with respect to health care. The scarcity of physicians, nurses, para-medical personnel, and capital facilities related to health in rural areas is well documented. In 1969, 134 U. S. counties did not have a single active nonfederal physician, and those counties with fewer than 10,000 residents had 2.4 percent of the total population but only 0.8 percent of the physicians and 1.9 percent of the hospital beds [4]. Additionally, rural physicians are aging, outdated, and would not be able to compete with peers in an urban environment. Research related to this important question of equity has often centered on redistributing physicians, attracting replacement physicians, and revitalizing antiquated capital facilities related to health care. Little has been done to ascertain the difference between *acceptable* medical care systems and *adequate* medical care systems. Moreover, it is unclear which—acceptable or adequate—would require more resources. Equity with respect to this service will be difficult to achieve because of lack of knowledge, scarcity of specialized resources, and the unique public/private mix that produces the services.

In economic thought a rather formidable schism exists between efficiency and equity. It is interesting and essential to note that in the matter of delivering public goods in rural areas, both efficiency problems and equity problems remain stymied because of the lack of knowledge about how factor inputs are transformed into public goods and how these goods themselves are eventually transformed into personal satisfactions. Production functions—even in a very primitive form—are needed if policy is to direct more or fewer resources into rural public goods production correctly.

The most difficult rural delivery system problems arise in a unique milieu of equity and efficiency. Certain public goods require the presence of a public official to certify rightness or wrongness, determine eligibility, and to document performance. AFDC and public assistance programs offer durable examples. The extent of poverty in rural America is effectively hidden by distance and by the personal and individual pride that goes with conservative agrarianism. Nearly a decade ago, the President's Commission on Rural Poverty began to uncover some evidence that poor people do exist in rural areas. Many of these poor are eligible for public assistance programs, but serving them is atrociously expensive and inefficient. By any standard, the marginal productivity of the case worker is higher in the ghetto where 20 families can be seen each day than in rural areas where eligible families or potentially eligible families may live 25, 50, or even 100 miles apart. Equity insists that society expand efforts in rural areas so all eligible recipients of public assistance programs can be served. However, efficiency and its attendant allocative rule of equimarginal returns dictates that added public assistance dollars go to urban areas. This situation is likely replicated in many states and for many kinds of services.

As apologetic as the conclusion must sound, equity in the provision of public goods must be approached on noneconomic grounds. An economist may well outline consequences of alternative schemes to provide equity, but the decisions of what to provide and in what quantity will continue to be evasive.

Public Goods Policies

Rural United States has always been favored by some kinds of public goods policies and shortchanged by others. As early as the colonial period, transportation and communication networks were pushed westward to disperse the citizenry and to assure national dominion by occupation. After nationhood was established, the road network continued to grow and was joined by railroads, superhighways, and graded roads in nearly every section of the country. Other policies related to education, fair trade, credit, and many aspects of community life eventually became part of policy directed at public goods delivery in rural areas. As the decade of the 1970s comes up on its midpoint, two aspects of these policies—their adequacy and their replication—need review.

Since the earliest policies were formulated, rural spokesmen insisted that if roads were built into rural America, the roads must be of high quality. This disposition reached its zenith during the 1930s when farm organizations sloganized their efforts to get the farmers out of the mud. More recently the same bent toward adequacy has been manifest in rural development programs designed to aid in financing water and sewage systems in rural areas. It is true that some areas need water systems and some need sewage systems, but it seems untoward to make categorical aid available for such a limited array of services. As a result of such policy, one can suspect that many areas adequately served by older systems now have new systems that meet engineering standards well beyond their needs. Single sets of standards yield over-commitments of resources.

By contrast, natural resource planners have begun to incorporate the idea of "separate facilities" into plans and policies. Under such schemes, one park is available for families with small children another park is set aside for aficionados of rock groups, and a third park is there for the gerontology set. Meeting differing needs with differing means has proven a useful way of providing recreation and keeping recreationists happy. The same principle should be expanded to other public goods. This expanded principle—perhaps the principle of differential adequacy—could provide a basis for public goods policy. Those areas that have a real chance at growth could be eligible for aid in establishing new delivery systems for water and telephone communications. Those with little chance could not, even under massive pressures of political favoritism and pork barreling, become eligible for such aid. This type policy would reduce the waste found in many contemporary delivery systems. It would match capital investment with an area's potential for growth.[5]

A century ago, major lumber companies operating in the West used the company town to provide differential adequacy. The company town was remote but often provided all the essential services available to persons in other, non-remote, pursuits. Houses, stores, schools, water systems, town halls, and fire departments all appeared under the auspices of the company. This system has been the object of much abuse because of its supposed infringement on individual freedom and its resemblance to monopoly. Critics of the system have overlooked the remarkable attribute of the company town: if 15 years of timber was present, the town had a 15 year design. If 30 years of timber was present, more intensive investment was made so facilities could last longer. If only two years of timber was available, the town was likely a cluster of tents. Different levels of adequacy were provided —one to match each level of forest availability.

The recommendation is not that policy makers design thousands of company towns to take the place of the towns presently found in California, Kansas, and Maine. Rather, the admonition is for those who sponsor policy related to capital facilities in rural areas to copy the practice of the timber companies and develop standards to fit circumstances rather than blanket policies that put durable equipment in semi-durable settings. Any of the publicly produced public goods that have high capital/labor ratios and are highly indivisible qualify for reinvestigation on this basis.[6]

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[5] It can be argued that this proposal derives from the growth point plans recently popularized by Niles Hansen and his followers. Such an argument has an element of truth. However, by allowing different sets of standards to direct capital investment in different communities, the problem of pointing a finger at one community can be avoided. A range in communities designed to serve a range of needs can emerge.

Population Distribution and Disequilibrium in Public Goods

The elaborate and truly great economic models developed by Ricardo, Walras, Marshall, Keynes, and more recently by Klein and Goldberger and Theil have all been anchored in the concept of equilibrium. In most economic models, equilibrium *per se* is not a specified goal, but rather a logical stopping place after all forces exerting themselves on the process of choice have been spent. The remarkable and more recent empirical work of Schultz, Heady, Johnson, and perhaps a dozen others has been perceptive in that these scholars have continued to look at either the anticipated state of equilibrium or the path over which equilibrium can be reached.

The continued march of people and capital to the city confirms that the urban and rural sectors of the U. S. economy are in a state of disequilibrium. This disequilibrium has become the object of scholars' attention. Very recently the urban/rural disequilibrium has taken on asymmetrical characteristics as one group seeks to leave the rural areas and another group seeks to enter. There is an important distinction between the two groups—a distinction that has a bearing on the collection of and delivery system for public goods.

For farm laborers, farm operators, and small community businessmen who become technologically displaced, the urban/rural disequilibrium is made manifest in terms of their capacities to earn livelihoods. Those displaced have more options in cities than in rural areas, and if employment is found, earnings are likely to be higher in an urban than in a rural setting. Disequilibria insists that people move, and since 1900, millions have made their way from rural to urban America.

Part of the current interest in redistributing the population stems from another disequilibrium —that related to amenities. Rural areas are not attractive because of job opportunities nor because of what is commonly perceived to be the truth regarding their school systems. They are attractive because they possess large volumes of amenities that can be appropriated at very low cost once the individual has located in the area. Those who notice this disequilibrium between city and town are a group quite different from the set who must, for reasons of survival, view the city as superior to the town. This amenity-seeking set includes those who need not depend on the labor market as a source of current income. Thus, the fabled leisure class, the retired, and the pensioned may be the only ones who observe and act on amenity disequilibria.

If redistributing the population is an important national goal, it may be necessary to direct massive disequilibrium toward groups who can respond. As such disequilibrium works itself out, gaps in equity and efficiency should also work themselves out to leave a tidier economic society than presently exists. Tax-subsidy schemes may be a viable means to achieve such disequilibium. Taxes and subsidies will have to be concentrated in the provision of public goods as well as upon cost structures of private firms. Schools, health care delivery systems, public recreation facilities, and systems of delivering water, electricity, and fuel to each person and each firm will have to be subsidized and developed. Similarly, amenity producing attributes of rural areas will require added investment. Sadly, if planned disequilibrium is to be a conscious policy, conditions in one sector will have to be permitted to deteriorate while conditions in another are improved.[7] Such selectivity is not consonant with present U. S. domestic policy and it is unlikely to become so.

Studying disequilibria has some appeal. The behavioral models of the ongoing body of economic thought need not be violated or even extensively revised to make such inquiries, but the interest of those who use the models will need to focus on the process of reaching equilibrium rather than equilibrium itself.[8] Answers to process-related questions could eliminate much of the anxiety that now resides in the breasts of rural Americans and in the minds of those who currently staff the many state agencies that deal with population and public goods problems.

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[6] The theoretical implications of different people having different needs (wants) in different settings is forcefully brought out by Mazek and Laird [6].

[7] This is not strictly true. If repopulating rural areas was the stated goal, public good collections in all sectors of the economy could still improve so long as the improvement in rural areas was relatively faster than improvements in other sectors. This condition would have to obtain in order to maintain the desired degree of disequilibrium.

[8] This theme is recognizable as a key element distin-

Stemming from the relationship between public goods and population distribution is the distressing body of literature dealing with the optimum size of place. In this literature, "low cost" is continually confused with "optimum." Beginning students of economics are taught that an optimum size of plant exists. This optimum is defined by the low point on the average cost curve of a firm in competitive equilibrium. Even though the competitive industry becomes more remote each year, the model has persisted in guiding research, in planning, and as a key figure among the many pedagological devices used to aid in understanding the first lessons of economics. Unfortunately, the optimum size of firm has no comfortable counterpart when applied to either single public services or to collections of services.

The troubles lies mostly in the concept of density. As population density increases, those public goods that require huge fixed-space forms of capital—streets, water systems, and sewers, for example—become less expensive, but those that are labor intensive and are related to information and control become more expensive when costs are reckoned in per capita terms. Just as E. H. Chamberlin's long-run economies and long-run diseconomies eventually define a "U" shaped cost curve for an individual firm, so the economies of compacting people and the diseconomies associated with congestion should spell out a "U" shape for cities. A problem arises in terms of transferring sizes in one congestion context to sizes in another congestion context. While 150,000 may be optimum with 3,500 persons per square mile, the same population can hardly be described as optimum for cities of other densities. If one size were optimum, the United States could be divided into the appropriate number of jurisdictional units and total costs of public services would be minimized. The task is not that simple, and the absurdity of the suggestion scarcely warrants comment except to say that key features that serve to bring about this absurdity include congestion, employment, income, race, location, and the split between exogenous and endogenous activities appropriate to uniform-sized jurisdictions. Economists who wish to work with public services in either rural or urban settings must modify their definitions so that simple "size" is not forced to play a dual role reflecting not only the number of people served but also their proximity one with another.

Discussion

Delivering public goods is no easy task. Delivering them in rural regions becomes more problematic. Expecting policies relating to delivery systems to play roles in gaining efficiency, providing equity, and redistributing the population makes the task even more abstruse. It is almost beyond comprehension to try to imagine a delivery system that allocates people across two dimensional space in an efficient and equitable fashion leaving no one with the desire to alter his circumstances.[9] Like the classic growth/full employment/price stability trilogy that trapped graduate students a generation ago, this efficiency/equity/population distribution triad with respect to public services leaves many confusing and inhospitable hypotheses for economists.

To solve the puzzles enmeshed in this triad, economists must first retreat for some reflecting, then emerge full bore into the some 1,500 counties that lost population in the 1960s, into the 862 counties that had no urban places in 1970, and into the countless communities in the United States that have lost people over the several decades starting in about 1920. The retreat will provide answers or access to research in the following fields and in approximately the following order:

(1) *Where do people want to live?* Evidence gathered to date is confusing enough to make one wonder if researchers really know. It has been held that the working class goes where jobs are, the middle class wants to live where its children will be happy, the upper class stays near centers of corporate power, and the jet set flits from place to place. Past this bromidic generality, the question remains: where do people want to live? The pollsters and the sociologists are trying to provide answers. In 1972 the Gallup organization found that over half of its respondents preferred rural (or small) towns and one-

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guishing production efficiency/welfare economics from institutional economics. The classic comparison between the two streams of economic thought is found in Ottoson [7].

[9] There is no denying that this test is too severe. Achieving perfection in each of these directions is too much for mortals to ponder. However, this condition is the ultimate logical goal of normative research and policy.

third preferred small urban areas. Adding evidence of a growing disenchantment with the cities was the preference change between 1966 and 1972. In 1966, 22 percent of Gallup's respondents preferred city life; in 1972, only 13 displayed the same preference [3].

Fuguitt and Zuiches complicate the locational preference question by reporting that people in Wisconsin do not want to live in the city but they want to live close—within 30 miles [2]. Dillman reports that residents of the state of Washington have an almost universal abhorrence of the city and much prefer the life of the village [1].

The weaknesses of all locational preference studies are fantasy in response, incomparability of questions, and the problem of aggregation. Much needs to be done to learn where people want to live and why they want to live there. The "why" aspect of this question leads to the second point.

(2) *What collections of public services do people want? What do they expect? And what will they settle for?* These questions put the economist at a disadvantage because they deal with goods and services that are exchanged in nonmarket contexts. Social scientists of a variety of persuasions may find out that people who wish to locate in rural areas want water, protection, sanitation, health, and amusement but, unless this demand is accompanied by purchasing power, the choice-making calculus of the economist is at best a weak tool.

Some public goods will be provided by command. Education, health, payments to eligible recipients of public assistance, and safety will be provided under dictates of local, county, state, or federal law. Production and distribution of these goods and services will not automatically or necessarily be economically efficient because decision makers who impose requirements on local communities are public officials who need not be entrepreneurs in the classic formulation of that term. So long as publicly produced public goods do not impose risks on those who create them, there is no strong incentive for efficiency in development, operation, or distribution. This aspect of public goods theory has yet to be comprehensively addressed by theorists or by public officials.

The theory of second best or a derivative of it has appropriateness in this arena. Lipsey and Lancaster elaborated this theory to show that the marginal conditions of maximum welfare do not have hierarchical order [5]. Extensions of this line of reasoning into rural area public good problems could be revealing. Does a hierarchy exist? Will a town that has the perfect fire control system, perfect schools, and a perfect water system but no hospital be as desirable (acceptable) as the well-doctored town with mediocre or even "merely adequate" fire control, schools, and water? These questions are unanswered in the literature, but they are eminently important in answering problems of providing public goods, social overhead capital, and economic overhead capital in rural regions.

(3) *Which public good-related variables are limiting, which are strategic, and which can be manipulated using policy?* Certainly some variables limit the production of public goods in rural areas. Most often funds are not available to put together combinations of goods that are ideal in every aspect, but some variables may also be strategic in the sense that altering the output of the strategic variable can demonstrably alter the production function or the growth function of the community.

Public officials have toyed with strategic variables in a variety of instances, but one of the most talked about and legislated public good strategic variables has been the water and sewage treatment systems in small towns. Somehow it has been felt that by assuring adequate supplies of these kinds of public goods, the process of industrialization and population redistribution could be accomplished. Again, economists have ignored the sociologists who have found that the pre-emptorily important attribute of locational preference is the domicile. Research and policy, then, must move toward housing in rural America, and the research must not be confined to measuring adequacy and counting empty dwellings. There must be renewed efforts at improving housing, encouraging low cost housing, and even providing low cost or no cost credit for those who wish to build and then reside in rural areas.

These three things—learning where people want to live, learning what they expect from their locale, and learning something of variables that can be manipulated—provide the basis for a program of research for this timely theme.

In conclusion, it must be re-stated that this paper has been speculative and has named only a few of the many visible problems besetting those who wish to meddle in the area of public goods in rural areas. The vast and extant literature on public goods has been too limiting to address effectively the time honored questions of economics: What? How? When? for Whom? The early naïveté appears to have given way to mid-search frustration and that frustration should lead to more portentous efforts in coming years. What is lacking is a meaningful, multifaceted concept of the community as an economic entity and an adequate counterpart of the private theory of the firm to deal with public goods. These can be developed if only economists will hold off on their headlong rush to design the perfect water tower and get it located in the least cost spot.

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Land Use Policy: Implications for Commercial Agriculture*

Lawrence W. Libby

Land use policy has evolved in the 1970s as one of the most pervasive concerns in American society. Its importance is acknowledged by groups of great diversity, though few agree on its bounds or content. In some sense land use patterns are a physical template of all the pressures inherent in location of people and things in modern society. Debate is focused on land but reflects more basic human motivations and values—stability, privacy, freedom, and income. Specific land use institutions[1] come and go. They are not spontaneously generated; they evolve from political bargaining among groups perceiving inequity in the existing set of decision rules.

Agriculture, a land intensive industry, has a direct stake in all of this. The particular land use institutions of current interest, however, are less important to the agricultural sector than are the pressures that created them. Further, while the immediate interest here is agriculture, the issues pertain as well to other open land uses. Attention will be focused on the most prominent "new" laws and proposals for comprehensive land use planning and control by state and federal government.

Pressures on Farm Land

The basic pressure underlying land policy concerns the redistribution of rights to "use" land.[2] Individuals or groups with little access to land, either because they live in land-poor areas or just do not "own" land, are seeking to pry certain rights loose from the ownership bundle. The basic intent of those espousing various land use proposals is to achieve a "better" distribution of opportunities for use of land, hopefully defined in terms of some community purpose. Those who currently have land rights, including farmers, greet with predictable skepticism these proposals for redistribution.

Land and environment

Much of the impetus for new land use proposals affecting farm land has a broadly defined "environmental" focus. Beyond the rhetoric of environmentalism, this aspect of land use policy is concerned with an assortment of previously unrecorded benefits and costs of individual land use decisions. Some of these entail clear monetary effects, others relate to prevailing aesthetic standards or to the long-run physical and economic viability of the resources.

Application of modern agricultural technology has facilitated release of land from farming to other uses. In that sense agriculture has contributed a degree of flexibility to land use planning. At the same time technology has produced side effects that generate costs for communities and individuals. The predictable response by those forced to bear the external cost has been the effort to shift those costs back to the farmer through regulation. Water contamination by pesticides, plant nutrients, and sediment has been of particular concern. Concentration of livestock in intensive agriculture has created effluent problems. Open field burning of crop residues and various types of agricultural processing create costly air pollution. Regulations and quality standards force the external costs back on the producer, clearly raising the costs of farm production [10].

Other costs are less precise though equally important. Farming can produce noise and odors deemed offensive under prevailing standards. These costs may be recorded in declining value of surrounding property or go unmeasured. Concerns that "ecologically unstable" monoculture crop production may result in net calorie losses and may limit disease resistance inherent in diverse plant communities have also been articulated [8, pp. 192–195]. While perhaps not yet a source of major political pressure for revisions

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[1] "Institutions" as used here refer to "sets of ordered relationships among people which define their rights, exposure to the rights of others, privileges, and responsibilities" [28].

[2] I agree with Raup that the distinction between land as a resource and land as a commodity is irrelevant. Conflicts arise because of differing human perceptions about what land is or should be. Some of these differences may be captured in a price a user will pay, others are more illusive. Without these differences, though, there is no policy [25, pp. 80–92].

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of land policy, these and related possibilities should be considered in long-run policy.

Farming as a land use also produces certain benefits to users other than the owner, benefits that these users would like to identify and then protect. Agricultural land is increasingly considered a valuable national economic asset. In times of world food shortage, production potential of American farms is clearly a critical national resource, for humanitarian purposes or balance of trade—wheat for oil, perhaps. Other returns are less economic or at least less directly so. New Jersey, California, Connecticut, and other states have undertaken land use programs essentially aimed at the open space character of farm land [21]. The presence of farms apparently contributes favorably to the living environment of a state or region beyond any direct economic activity generated by the business. The contributions might include availability of "farm-fresh" produce, relatively attractive open countryside that is uncluttered and free of air pollution, and in some cases, recreation. Farms are even thought by many to be an essential element of American life—just a nice place to know about. At least people *think* these benefits exist, and that is the important thing.

Price pressure

Few land uses return *less* per unit of land than agriculture and other open land uses. Price of land invariably reflects expected future earnings discounted by some measure of uncertainty. The possibility of higher future earnings is particularly significant for open land. Chances for future development, no matter how remote, can affect the farmer's willingness to invest in the business. Far more land is affected by the possibility of development than can ever actually be used. The frequent result is that much land is prematurely pulled out of farming by unspecified development potential when land allocation relies entirely on a land market replete with misinformation.

Land and political boundaries

Another source of pressure for innovation in land management institutions concerns the capacity of small governmental units to internalize effectively the impacts of private decisions on farm land. Their reliance on land taxes for local services is a formidable incentive for the development of open land. Development may in fact be best for everyone involved, but to the extent that retention of farm land or modification in timing and pattern of change generate social benefit, some public action would be useful. Any social benefits would clearly accrue broadly to the state or region. Small units of government—a township or even county—might be unreasonably burdened if asked to bear the direct costs for a program that would produce those benefits.

Obviously, agriculture and open land are not uniformly distributed. There is no reason to expect residents of land-rich localities, whose private use decisions are in some sense precluding opportunities for residents of more populous areas, to alter their decisions unilaterally. They have nothing (or little) to gain from such action, and much to lose.

Policy Response

Proposals for new land planning and control institutions have surfaced at the national level and in many states. Their predecessors have haunted the legislative halls for several years and further revision is likely. Some sort of national program to urge, encourage, or require local and state action for land use planning and control is nearly a certainty in the mid-70s.

National

Attention has been focused on companion proposals introduced by Senator Henry Jackson (S.268) and Representative Morris K. Udall (H. R. 10294). The former was passed by the U. S. Senate on June 21, 1973 by a vote of 64 to 21; the latter was introduced in the House in February 1973 and on June 12, 1974, was stymied by seven votes in a rule measure on the House floor [26]. It will be back in some form in the 94th Congress. Roots of the two proposals go back to the Public Land Law Review Commission report of 1970 [24] and the model land use code of the American Law Institute [1]. While their provisions will not be detailed here [29, 31], their basic purpose is to encourage states to undertake planning and land control programs by providing federal dollars for those states meeting federal planning guidelines. Whatever their final form, these guidelines clearly will be aimed at pressure sources identified above—land uses with significant spillover effects. The U. S. Department of Interior will be responsible for a wide range of coordinating activities. These are not the *only* national proposals, but clearly the most significant.

The political climate surrounding these national initiatives to guide planning and control of private land has been turbulent. Provisions to withhold certain federal funds from states that fail to act have died painfully in Congressional committee rooms. At issue was Department of Interior oversight of spending programs of other agencies—an untenable situation in a competitive bureaucracy. Support for federal spending in states was predictably strong at first, though perceived "strings" attached and apparent redistribution of rights from state to the national level have caused some second thoughts. While neither proposal mandates state action, the feeling by some is that no state can resist the money. Once the flow of money is established, states would be acting as "agents of the federal government" in complying with minimum planning standards [6, p. E269].

Economic slowdown in 1973–74 has apparently contributed to a substantial backlash against further environmental legislation, including these national land use proposals. The National Environmental Policy Act, cornerstone of present environmental policy, has been blamed for everything from high food prices to the energy crisis. The major complaint has been that NEPA and these land use proposals are too loosely defined and become an umbrella for all sorts of legal actions to limit development. In arguing before the House Rules Committee for indefinite postponement of H. R. 10294, House Minority leader John Rhodes cited recent court actions delaying the Alaskan pipeline and limiting timber harvest by the Forest Service as examples of environmental extremism that occur with open-ended legislation.[3] A subsequent suit has challenged the entire 1974 budget of the Forest Service, pending investigation of environmental impacts. The underlying concern here is the increasingly vigorous articulation of the social element of individual land use decisions, implying a wholesale redistribution of land use rights from persons with fee ownership to the ill-defined "general public." Markets, where transactions between owners can internalize all kinds of expected utility from land, are replaced by courts for those "users" damaged or excluded from the market for some reason. Congressman Rarick of Louisiana summed up the opposition to this redistribution of land rights: "We must not allow over-reaction to environmental concerns to overshadow our concern for human rights and basic freedoms including the right of private ownership and control of property" [6, p. E269]. Idaho's congressman Steve Symms completed the thought, ". . . . freehold property ownership still forms the basis of human liberty and a republican form of government. Human rights and property rights are inseparable" [29, p. 103].

Interests and areas of the country benefiting most from current distribution of land use rights and the set of institutions for land transfer have been most vocal in their opposition. States or regions with plenty of land but relatively poor economic circumstances welcome sale of land that might generate income and jobs. For them the potential social costs of these private transactions are far outweighted by potential advantage.

The American Farm Bureau Federation speaking for over two million member families, argues that major land use discretion should stay with the owner. When governmental action is unavoidable, that action should be at county or local level and the private owner should be fully compensated for any loss in land value that results [30, p. 364]. Many farmers see national or state land use initiatives as the latest in a series of costly interventions—NEPA, sedimentation controls, federally mandated health and safety standards, and now this. They have opposed state initiatives as vigorously as national. The real concern is not the level of government, but what those governments might do. Farmers apparently anticipate that fewer rights will be transferred from owner to public when a unit of government serving more owners than "public" has decision authority.

Timber interests have been equally skeptical, though seemingly less vocal than agriculture. Because of 187 million acres of public timber, decisions made in Washington strongly affect all forest use policy. National land use programs, requiring particular attention to environmental characteristics of forests, might shift some of that discretion down to the states or laterally from Agriculture to Interior, thus upsetting the fragile set of compromises and understandings that have evolved over the past 50 years or so. Farmers worry about power going *up* to the states; foresters worry about losing it *down* to the states; both fear a power redistribution favoring those who experience the secondary effects of private decisions.

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[3] Impeachment politics has reportedly lent currency to this argument. On the day before the crucial House vote, Interior Secretary Morton publicly reversed his position and opposed H-10294. Representative Udall blamed Presidential "grandstanding for the right wing."

State

The real action in public influence over private land decisions is at the state level, rather than the national. Land use planning and control programs affecting agriculture are in operation or under consideration in about 40 states. The degree of state level influence varies considerably among the states. Only Hawaii has state-wide land use zoning. Several—Florida, Oregon, Michigan, Maine, for example—have limited initiative to protect specific resources deemed to be of state-wide significance. Included are shorelands, land bordering scenic or natural rivers, wetlands, flood plains, wilderness, power plant sites, and other areas of critical state concern. While care is taken in these laws to protect Constitutional guarantees of due process and just compensation and to provide a significant decision role for local governments, state initiative clearly implies an allocation of land use rights emphasizing the common property components of land benefit. The police power offers the basic legal rationale to protect these rights held in common by all citizens, in trust to the state. The state might prefer that local jurisdictions enact and enforce the zoning, but retains final authority. In Florida, for example, state land development regulations can override the local rules if the latter are deemed to be inadequate to protect "areas of critical state concern" [5]. In Michigan local zoning ordinances to protect shorelands must be approved by the state Natural Resources Commission [19]. All establish a strict permit system to control development in these areas.

Proposals for broad state designation of "critical environmental areas" have been stymied in Maryland, Massachusetts, Washington, and Michigan where interests perceiving loss from the implied redistribution of rights have held the line. Of major concern is the open-ended definition of "critical areas," leaving too much discretion with the planning agencies.

Another group of state land use programs for open land and agriculture implies a greater concentration of use rights in fee simple ownership. That is, private owners are *encouraged* to use their land in ways that generate broader social benefits. Differential assessment laws in over 30 states attempt to encourage agriculture as a land use by reducing the real estate tax burden on actively farmed land. Some laws involve deferred taxes, others require certain land use compliance from the owners, but basically state land policy objectives are sought through the responses of individual owners to publicly provided incentives [12]. Unique incentive programs exist in New York and Michigan. New York encourages local governments to establish agricultural districts. Michigan's program involves an income tax credit for the amount by which property taxes exceed 7 percent of a farmer's income [20].

As of mid-1974, transfer of land use discretion is still very tentative in states like Arizona, Nebraska, and Iowa where land remains primarily a producer's good, and fee ownership is the predominant source of access to land. Nebraska has enacted a Constitutional amendment permitting differential assessment of farm land; Iowa state legislators have investigated the alternatives for preserving agricultural land. Still other states—Oklahoma, Kansas—are almost totally silent on the matter.

Several states are investigating the feasibility of establishing a market for rights to develop land. This approach acknowledges the need for both open space and development and creates a market for the development right that may be transferred from a low density district to a district where greater density is possible [9]. One proposal in Michigan recommends that the state purchase farm development rights at market prices to provide open land with state controlled development potential [17].

The particular distribution of land use rights implicit in a state land use program is clearly a function of prevailing economic circumstances in that state. Raup suggests that major redistribution of land rights has only come in response to severe and pervasive crisis—threats of blockade or food shortage in Europe, for example, generated support for immediate action [25]. Similarly, the imminence of economic or environmental calamity was essential backdrop for major state initiative in Hawaii, Vermont, and Florida.

Other observers perceive a *quiet* revolution in the form of gradual though continuous erosion of land use discretion retained by individuals and local governments with subsequent build-up in state and regional government [3]. Impetus and support apparently come from a population whose relationship to land is primarily secondhand—they gain or lose from the actions of other owners rather than from ownership itself. In any event, real barriers to state action are political and economic, not legal.

Implications for Agriculture

Open land, much of which is farmed, is the central focus of pressure for changes in land management institutions. There is economic pressure to develop, political pressure to preserve, and farmers are caught in the middle. There is an important distinction here between land use controls and those environmental controls more directly related to air, water, or noise pollution. Both entail adjustment in the set of management options available to the farmer; both could increase costs of farm operation. Land use institutions, however, are focused on the quantity and quality of land available for use and sale by agriculture, while other environmental controls seek to alter production practices on the current land supply. A primary goal of new land allocation rules discussed here is to identify specific areas that should stay relatively open, for whatever social benefit might result.

Direct action at the national level to control allocation of farm land into and out of fee simple ownership for environmental objectives is unlikely. The important effect of national legislation will be as a stimulus for state and local action. As noted, action comes first in those jurisdictions where failure to act would entail clear and pervasive cost for many people. Support for general precepts of environmental balance will not translate easily into votes for major state level action. Voters look for immediate and separable effects. Our political system responds to crisis—we are not much good at anticipating things. Even the availability of federal dollars cannot manufacture crisis. Congressman Rarick of Louisiana warned his constituents, ". . . it must be pointed out that none of this money is to be used in any productive manner or to contribute to our economy. It merely goes to pay the cost of expensive planning specialists who are supposed to know more about what is best for a community than they themselves or their elected officials" [6, p. E269].

Whether initiated by the state, localities, individual owners, or some combination, designation of open land districts has important implications for agriculture.

State initiated open areas

Highly productive farm land is clearly eligible to be considered an "area of critical state concern" in its own right. In both versions of the National Land Use Planning Act of 1974, areas of critical environmental concern are defined to include "renewable resource lands where uncontrolled or incompatible development could endanger future water, food, and fiber requirements of more than local concern . . . to include agricultural, grazing, and forest lands." In the 1973 Michigan proposal [18], an area of critical environmental concern could include "soils of USDA classes I–IV or otherwise suitable for agricultural or horticultural purposes." A similar proposal in Maryland included "productive agricultural lands" on a list of characteristics to be considered in designating areas of critical state concern [16]. While neither bill got very far on first outing, the principle has been established.

Florida's critical area law (Act 380) has quite a different focus. It specifically prohibits regulating highways, utilities, and *agriculture* on behalf of critical natural areas. Florida's intensive agriculture is viewed by many conservationists as a threat to the delicate fresh water balance of the state [5, 22]. Agriculture in Florida has been characterized, probably unfairly, as a holding pattern for development. Further use of the Florida law may treat agriculture differently—the orange groves and intensive vegetable lands are critical to the economy and attractiveness of the state.

Designation of specific farm acres as "critical environmental resources" for the state can have several possible impacts for the farm. If highly productive farm areas are designated, the following types of impacts may be anticipated:

(1) Land value will be affected—if the land already carries a value increment anticipating future non-farm use, that increment will be reduced; if it has no such value when the designation is made, future levels will be constrained by the permitted uses. The lid on future land value may affect borrowing capacity for the farmer. Rural bankers in Maryland predicted such an impact from the Maryland proposal [32]. Property taxes will also reflect these use constraints. If the farmer is already paying taxes on development potential, his tax basis will decrease to agricultural value. With less incentive to speculate on future development possibilities, the farmer could concentrate his management energy on his business and investment needs. All of these impacts will be affected by the length of time for which the critical areas designation is made.

(2) Market value for nearby farm and open land not in a district could go up substantially, depending on development pressure. Such has

been the case following enactment of the Coastal Zone program in California, where developers have scrambled to acquire the few remaining unrestricted areas. In some cases developers have simply postponed their plans to "wait out" the restrictions. Holding land does entail opportunity costs, though, and some owners have sought variances on the basis of undue hardship. Agriculture will be a poor competitor on these lands—a California farmer/developer estimated that even the most profitable crop mix on his 40 coastal acres would lose $6,000 a year [13, pp. 31–36]. In any event, development potential and related values will be redistributed. If there are significant areas of land both *with* special designation and *without* it, in a single taxing jurisdiction, the tax load will be redistributed. If, on the other hand, a local taxing unit loses much of its development potential, future revenue needs will have to be met through a rate increase.

(3) Restrictions on farm practices may be encountered when these districts are close to population centers. Given the nature of political support for open space legislation, proximity to non-farm population is likely. There might be strict regulations on pesticide use, construction related to the farm, machinery use and other farm practices that appear to generate social costs. The whole permit approval procedure would focus political attention on farm operation. Burden of proof would be on the individual seeking to change land use in the district, to demonstrate that the change would not compromise the intent of the designation.

A second type of critical areas designation directly affecting agriculture may be aimed more specifically at the aesthetic or environmental character of open land. Farming may be sought essentially as a caretaker for attractive rural scenery. The land involved might be of lower productive quality—hilly or uplands. This land is also less responsive to intensification and more likely to produce run-off problems. To the extent possible, farmers will intensify production on better land and maintain some sort of multiple-use character on poorer land in a critical areas district.

When the primary objective of a critical area designation is preservation of an ecological setting threatened by agriculture, increased costs of farm operation are inevitable. The Big Cypress area in Florida is an example. Proposed regulations, later modified, would have restricted burning, ditching, filling, dredging, pumping groundwater, and road-building on lands in the 2450 square miles of watershed.

Local initiative for open areas—the New York case

The general types of effects on agriculture will hold whether state or local governments initiate action to maintain open land. But the question of whether those effects harm more than they help may be answered differently at different levels of government. In New York, for example, farmers request designation as an agricultural district. Their action is clearly sensitive to needs of the farm business [7, 2]. The presumably rational farmer would not apply otherwise. He *may* respond to social pressure from the surrounding community or try to insulate his business from development pressure for a time, but whatever the motivation, it reflects his own judgment. The declared intent of the New York Agricultural Districts Law is to facilitate active agriculture, rather than to preserve a particular land use pattern.

Application for a district must come from owners controlling at least 10 percent of the land in the proposed district, or 500 acres. Total consensus is not sought. Conceivably some farmers could find their future options constrained by the actions of their neighbors rather than their government. Once a district is formed, agriculture is clearly designated the primary use. Local or state regulations that might compromise or unreasonably restrict farming in those areas are prohibited. No attempt is made to alter or constrain agriculture for the social benefits it might produce. If commercial agriculture contributes to the aesthetic character of the region, so much the better. The New York program has been termed a "soft non-authoritarian alternative" to the absolutes of police power implied in direct state action [7].

This type of program has appeal. It attempts to accommodate rather than confront the self-interest of land owners. Broad support among the urban and suburban population of New York confirms that agriculture *as* agriculture contributes social benefit. Over 1 million acres have been designated for an initial eight year period. The hope is that 5 million of the state's 8 million cultivated acres can be preserved in some way [2, p. 2]. The remaining acres may be harder to pin down, however.

Agricultural districting does not attempt to address the broad expression of open land benefit implied in "areas of critical state concern."

Pressure for other land use institutions, or at least application of the districting concept to other open lands, may be anticipated in New York. The agricultural districting effort has worked within its limitations; by retaining maximum discretion for the farmer it has encouraged agriculture and bought some time; but its long-run response to pressure on open land should not be overestimated. Other land programs emphasizing owner initiative have the same limitations. At some point people will be willing to trade some inconvenience for the farmer, and whatever that may do to supply of open land, for more direct land access.

A Policy Strategy for Agriculture

The basic impact on agriculture of these broad land use programs is apparently to intensify further food production on those lands physically, economically, and *politically* capable of sustaining production in the long run. Pressure for non-production uses of farm land will continue, but so will demand for food. The prevailing policy challenge is to encourage a rate and pattern of intensification that accommodates all three capability parameters.

Physical capability, including some notion of ecological stability, is perhaps least susceptible to manipulation, though additions to physical supply of farm land have been observed in Florida and parts of the west [15].

Economic capability imposes prices on physical land characteristics. It has been the key dimension of resource adjustments in agriculture in the past 30 years, characterized by increasing substitution of capital for labor.

Political capability refers to the willingness of non-production "users" of farms to permit adjustment to economic capability on *those acres* that can take it. A complementary adjustment would emphasize aesthetic or environmental characteristics of lands that will grow less. This is not a license to ignore social costs of intensive agriculture, but simply to encourage the public to look elsewhere for land qualities not consistent with active farming. Clearly *some* highly productive acres will be more valuable in some other use. Absolute land scarcity on a macro-scale is unlikely, though local battles on specific acres may be fierce.[4] The charge in building a land use program sensitive to agriculture is basically simple:

(1) Document the characteristics, location, and needs of agriculture as a use of land. Emphasis must be placed on the set of conditions essential to successful agriculture to dispel the notion that preserving land preserves agriculture.

(2) Initiate land programs that explicitly acknowledge the role of the farm manager in intensive food production. Retaining land is not enough. The economic circumstances that encourage active farming must also exist in those areas. Food production must be increasingly sensitive to air and water quality needs and may contribute substantially to the aesthetic character of a region, but policy should acknowledge that not *all* farms can provide *all* the benefits of open land. When the judgment and initiative of the land owner are instrumental in the land program, chances for success in retaining agriculture would seem to be better.

(3) Encourage retention of other open land, farmed *if possible,* with greater emphasis on its environmental character. This may be the uplands, or floodplains, or soils of low productivity, where openness or attractiveness is the essential quality sought. Some direct non-farm use may be possible—fishing, hunting, hiking, and even snowmobiling have been permitted on private farm land without serious disruption.

The challenge for agriculture is to articulate clearly and forcefully the distinction between farming and open land for other uses. With a few exceptions that distinction has not come through in state and national land use policy. If agricultural areas are to be "areas of critical state concern," explicit information about agriculture should be part of the evaluative process. This will require active involvement by specialists who know agriculture. Economist Don Paarlberg has warned that agriculture must be concerned about who controls the agenda for agricultural policy. It is bad enough to lose the control of the agenda, he says, but more critical is to *know* you have lost control. National and state land use policy has evolved as a "white-hat issue" basically concerned with natural beauty, land stewardship, and other unquestionables. Discussion has centered in the Department of Interior at the national level, and the state counterparts in Departments of Conservation, or Natural Resources. Agriculture has been conspicuous by its absence. The implicit rationale for agriculture's disinterest has been that land use policy is essentially peripheral to agricultural production and therefore of marginal interest to legitimate professional agriculturists. The obvious problem with this reasoning is that land use policy is responding to demands for land use patterns that *directly* affect availability of land to farming.

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[4] Otte has estimated that four or five times the amount of land taken for urban uses is shifted to lower intensity agriculture or idled because further cropping is uneconomic [23].

As noted, agricultural interest groups have consistently opposed, studiously ignored, or smugly disregarded the types of national and most state land use initiatives discussed in this paper. Not until fall of 1973, reports the American Farm Bureau, has land use legislation become a consistent agenda item at state and regional meetings. The essential thrust of most opposing testimony rests on the familiar shibboleths of private property ownership. Any restriction of private discretion, they argue, must receive full indemnification. "Compensatory zoning" is the legal expression gaining considerable favor among many groups. If planning and land use control are absolutely necessary, only the most local government should do it.

A major contention of this paper is that agriculture must deal more directly and substantively with policy choices in land use. The strategy of delay and sloganeering can produce temporary concessions, but will be suicidal in the long run. Abstract discussion of private rights versus public is irrelevant. The question is *whose* rights count enough to gain "public" status in legislation. Even Constitutional protection of ownership has few absolutes—interpretation is some function of the prevailing balance among competing demands for use. Bosselman, Callies, and Banta vigorously defend the argument that government is capable of considerably more redistribution of rights than accomplished through police power thus far, with virtually no requirement for compensation [4]. In addition, some communities have experimented with zoning—resulting innovations suggest new life for this traditional technique [14].

Total reliance on local government as the level most likely to generate land use decisions protecting the discretion of farm owners may also be fallacious. By their very nature, local governments direct their attention, revenues, and powers toward the needs and preferences of the immediate constituency. Perhaps current land ownership and demographic patterns combined with reliance on land taxes for local services does favor owners of open land. But a township or county government answering primarily to non-farm rural or suburban constituents, possibly even freed by tax reform from the yoke of increasing land use intensity, might be increasingly sympathetic to "preserving" the non-production benefits of farmland with little concern for or understanding of the needs of farmers. A moratorium on rezoning for development has been enacted in Fairfax County, Virginia—an understandable reaction to a deteriorating local environment. Similar proposals have arisen elsewhere.

Well-conceived state level land use programs, even those sanctioned under a federal land policy, may in fact be more sensitive to the combination of factors necessary for viable commercial farming. We must assume that the farmer is more than just a land value speculator, while acknowledging his reluctance to sacrifice all possibility of buying or selling land consistent with farm operation. The farmer cannot expect unlimited land use discretion in the future. Our changing political environment just will not permit that. The challenge for farmers, farm interest groups, and professional agriculturists is to participate actively in building land use institutions that retain the elements of discretion necessary for agriculture. Given the dispersed character of agriculture and the complexities of understanding and documenting the needs and contributions of agriculture, those institutions may need a state or regional base.

Conclusions—Policy Choices

The essential policy issue that emerges from controversy over land use planning and control is *who will pay* for the benefits perceived from altering the pace and pattern of land use change. In Coasian terms—who must (should) buy out whom? The capacity to impose costs on others is an expression of relative political power. Decision institutions formalize these power relationships through the rights of the various interests competing for scarce resources [27]. Pressure for new land use programs has been described here as a push for reallocation of rights to land, and therefore the costs of this institutional change. But allocation of costs affects the outputs of land use institutions. Those who support a certain distribution of the cost burden should be aware of the impacts of those costs on the land use pattern.

Land use controls, particularly those aimed at "open space," seem to generate widely dispersed small increments of benefit. Direct cost of land control, on the other hand, may be highly concentrated—the few owners whose land use options are limited, the local government that loses property tax base, the region that sees limits on its potential for development. Beyond the obvious questions of equity is the matter of how the qualities sought in land regulation are affected by that cost distribution. To a large extent, perhaps more so than perceived by most groups lobbying for open space programs, the critical environmental resource known as agriculture requires major discretionary action by the person managing that land. Historically, land use planning has been concerned primarily with developing or *not* developing land. Open land was valued only for its lack of activity, or as a residual for future development, rather than for the combination of factors defined as agriculture.

If land policy is needed to retain agriculture and if positive exercise of management discretion by the owner is necessary for the qualities desired, then those demanding the non-owner rights may have to bear some of the cost of providing them. This may mean compensation for acquired rights, compensation to the local government losing land tax revenue, or emphasis on owner initiative, as in New York. By the same token an increasingly sophisticated voting public will not pay for rights or qualities that it never gets. Open-ended incentive programs—including preferential tax laws for farm land—are probably an unacceptable balance of discretion on the side of the farmer. Support for controls to retain agriculture may be broad, but it is shallow—very sensitive to evidence of windfall gain for the speculator dimension of farm ownership. Restrictions of all kinds are an increasingly familiar fact of life, and land owners will not win compensation for controls that still permit significant use rights.

A second major choice in land policy concerns distribution of authority among levels of government. There are few dependable rules to go by in deciding what will be done where; there are distinctions between legality and political acceptability. Charles Haar has written of the ". . . cumulative deterioration of the fit of any set of governmental institutions with the needs and wants of the constituencies subject to their jurisdictions" [11]. Increasing evidence of interrelatedness across local boundaries suggests continuing attention to decision units that *can* allocate impacts between those who gain and those who lose in the search for consensus. The smallest local units have important strengths, but retaining agriculture and open space is not one of them. Metropolitan government encompasses open land and concentrations of people, but has not yet achieved sufficient political legitimacy nation-wide to undertake major land controls. The state, with significant Constitutional authority and a well tested system of representative government, may be the most appropriate level for directing aware consideration of agriculture. The state department of agriculture must take the planning process far more seriously than they have thus far. Effective planning can not be done exclusively by one agency or one level of government. There must be a sharing of responsibility and authority.

Care must be taken to avoid insulation of planning from people affected by it. Pressure for local rather than state planning largely reflects a feeling of isolation from big government. Bureaucracy, politicians, and government in general are not high on the credibility list—the more distant the government, the less its credibility. Agriculture has an impressive network of contact with its constituency, through soil conservation districts, cooperative extension, and others. These could help build and maintain a believable planning process.

A third area of public choice concerns the structure of a future agricultural industry. Reports of the demise of the extended family farm and takeover of land by government are *at least* premature. The role of private management initiative is great and not likely to decrease. Several possible impacts on structure may be identified. Increasing regulation will affect the cost functions of agriculture and will likely increase the economic advantages of further consolidation and substitutions of capital for land. Greater dependence on production technology may in fact contribute to environmental problems that led to initiation of the program in the first place. Under some conditions, land planning may effectively *increase* supply of farm land by restricting other uses, thus altering the current trend in farm numbers and keeping land prices down. To the extent, however, that farmers rent from owners holding large amounts of land as a long term hedge against other investments, or for short run capital gain, controls could limit that farm management option. Land corporations need favorable expectations of future appreciation in the value of that asset to attract investment funds. Specific knowledge of the land quality and ownership pattern is necessary for accurate prediction of effect of controls on structure in any given area. In general, though, relative impacts of alternative land use controls on the conditions conducive to private disaggregated management should be considered.

A fourth consideration in building land use institutions is the degree to which the most productive farm land of the country may be a major national asset; just as vital to the future economic health of the country as is oil or pure water or a viable real estate industry. There are wide ranging opinions as to how critical the land supply problem for agriculture really is, for the long haul. Some have called for extraordinary measures to "save" farming; others suggest we already have too much land in farms. As is usually the case, there is evidence to support both positions. Agricultural land may have the common property characteristics described as the "pool effect" in ground water supply problems—the contribution of each acre or each farm or each farmer to the total industry may be insignificant. It will not be missed, so there is little push to save it. The cumulative effects of land policy that overlooks the social costs of land use decisions based strictly on the marginal costs of individual farm enterprises may lead to serious depletion of an irreplaceable, or at least very costly, national asset.

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Session 11

NATIONAL POPULATION DISTRIBUTION POLICIES AND PROGRAMS

Discussants: Frank M. Goode, Pennsylvania State University; Burl F. Long, Virginia Polytechnic Institute and State University; Dean F. Schreiner, Oklahoma State University

Session 12

INTERFACING THE CLASSROOM AND THE WORLD OF WORK

CHAIRMAN: WAYNE D. PURCELL, OKLAHOMA STATE UNIVERSITY

Off-Campus Work and Study Experience Programs for Undergraduate Students in Agricultural Economics and Agricultural Business Management*

MILTON M. SNODGRASS

Historical Perspective

THE CONCEPT of integrating occupationally based study and work experiences as part of the curriculum for undergraduate students in higher education is not a new idea. However, there has been a resurgence in the awareness and use of the concept for agricultural students in recent years. Defined broadly, the concept encompasses any off-campus work or study experience with a private business or government agency which is organized by the university for which academic credit and/or pay is received by the student. Some of the more common names given to these efforts include "work-study programs," "internships," "sandwich programs," and "cooperative education programs." This paper will discuss the usage of such programs in historical perspective, discuss their philosophical basis, discuss the place of programs in the curriculum, describe the nature of programs currently in use by departments, discuss the advantages and disadvantages of such programs to the student participant, the university, and the participating business or agency, and detail an operational framework for program implementation.

Long before the development of today's extensive educational system, Francis Bacon in the 17th century said that "studies teach not their own use; there is a wisdom without them, and above them, won by observation." In these words we find a philosophical root for work-study programs. In early times society depended upon apprentice programs to teach craftsmen the trades necessary for society to subsist. The little theory a craftsman needed could easily be taught along with his practical training in the apprentice program. However, as time went on and society's demands for technological progress increased, the complexity of the educational process increased beyond the scope of the apprentice programs which were not able nor designed to cope with equipping the rising class of engineers and scientists for their professions.

In the late 1800s, recognizing the need for the integration of theory with practical application, engineering schools, in particular, tried various ways to combine them. Some colleges introduced regular shop courses into their curriculums to give their students a practical feel for what they would encounter once they were in industry. Worcester Polytechnic even went so far as to operate a shop on a commercial basis producing articles for sale. Others advised work for a period of 15 months in industry between their junior and senior years. Some colleges also required students to do summer work in approved industrial plants.

The educator given formal credit for combining work and study as an integral part of the educative process in higher education is Dean Herman Schneider who inaugurated cooperative education at the University of Cincinnati in 1906. He believed that if college students would spend a portion of their time working in industry, applying the knowledge and theory gained in school to practical work situations, their education would become richer and more meaningful. While originally his students alternated between the classrooms and industry on a weekly basis, the periods of alternation have since lengthened so that most universities using the so-called co-op program now use alternating quarters or semesters. On a somewhat less structured basis, institutions have also established what may be re-

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ferred to as a non-resident term where students may alternate at regular or irregular intervals working with various business, industrial, and service organizations.

Recent history

Prior to 1950, it was not unusual for agricultural curriculums to include a "practical experience" component. With burgeoning student bodies after World War II, there were adequate jobs for graduates; and with an increased number of academicians espousing the virtues of "education for education's sake," work experience programs fell in favor. This stance has now reversed itself—no doubt spurred by the student unrest in the '60s which included a cry for "relevant education." The growth and success of Colleges of Technology inside some of our major universities, as well as new institutions outside, aided a turnabout. Student awareness of the need has also heightened in the face of a tighter job market. So in the '70s it is now fashionable to be "practical" and offer work experienced based programs.

A number of reports verify these general conclusions. From the White House Conference on Youth in 1971, one youth stated:

> Educational systems and programs must be made relevant to students' life situations and the probable futures that their world will offer. Students must be permitted to explore various areas of interest. . . . Students need to be allowed to learn outside the formal classroom and to receive academic credit for this they also need to move freely between vocational and academic programs. [3]

The internship concept also was given impetus by the *Report on Higher Education* in 1971 which states:

> Thus it is argued that the task is . . . to meet the demand for relevance in education by developing new curricula. We doubt whether many students have had sufficient exposure outside the educational system to know what a relevant education might be. Both students and a faculty need more experience away from the campus. . . . Educational internships in government, industry, and social service, cooperative education programs, work-study programs, and the like should be greatly expanded. [5]

The Carnegie Commission on Higher Education (also in 1971) issued a special report with a rather strong statement:

> We believe not only that *all* colleges should encourage prospective and continuing students to obtain service and work experience, but also that some colleges may wish to *require* it before admission or at some point during matriculation and could, in fact, in appropriate instances, grant credit for it toward completion of degree requirements. The report recommends further: that the expansion of post-secondary educational opportunities be encouraged outside the formal college in apprenticeship programs, proprietary schools, in-service training in industry, and in military programs; that educational credit be given for the training received, and that participants be eligible, where appropriate, for Federal and State assistance available to students in formal colleges. [1]

There is also a revival of the focus in recent years on "non-traditional" educational methods in higher education. A research report of the American Association for Higher Education summarizes the situation as follows:

> One of the most dramatic developments on the academic scene in recent years is that of granting credit to students for learning in non-traditional ways. There seems to be the realization now that classroom learning—however we conceptualize it —is simply no longer sufficient; it must be supplemented by other kinds of experience—at work, in the home, through internship and field activities, and in travel and service abroad. [4]

The Commission on Non-Traditional Study concluded that non-traditional study is the revival of

> . . . an attitude that puts the student first and the institution second, concentrates more on the former's need than the latter's convenience, encourages diversity of individual opportunity, and de-emphasizes time and space or even course requirements in favor of competence and, where applicable, performance. It is not a new attitude; it is simply a more prevalent one than before. [2]

Philosophical Considerations

As workers in an applied discipline, one would doubt that agricultural economists would completely reject the notion that occupationally based industrial experience away from the campus would have no merit whatsoever. Disagreement probably lies in the amount of academic credit that might be formally given for such experiences and the most expeditious way to integrate them into the curriculum. During a period of study leading to a baccalaureate degree, most agricultural economists would likely agree that a student should develop a capacity for: (1) critical analysis and problem solving, (2) taking a responsible position in society, (3) forming a philosophy of life—living harmoniously with one's self, other people, and the physical world, and (4) continuing one's education. Using more general categories, the objectives of a university education might be considered to fall into two groups: the first pertains to individual development for self understanding and fulfillment, good citizenship, and living harmoniously with other people and the physical environment, and the second involves career education which includes the component of developing some employable skills. In curricular discussions among agricultural economists, there are wide variations among the percentage emphasis that each of these two areas should receive. To the extent that one argues that the percentage for the career education emphasis should be relatively higher, one would suppose that such an individual would also support off-campus work-study based experiences to a greater degree.

The majority of those individuals who would espouse work-study experiences as an integral component of a university education are likely in the "progressivist" camp with regard to educational philosophy. The progressivist believes that a person is an experiencing organism, an integral part of the flow of events, relations, feelings, thoughts, and things. He believes that the student's behavior is wholly within the realm of his experience. Like other animals he is engaged in the recurrent conflicts, the defeats and victories of the struggle for existence, but his powers are very different. This is especially true of his intelligence and his ability to face and resolve problems.

To utilize his intelligence, he must also make full use of his environment. More exactly, he must have the opportunity to share freely, steadily, and richly in the events of nature and culture immediately around him. A university or any other school is good when it enables him to grow through such sharing, when it provides ways of expression for his total behavioral pattern, and when it permits him to act in relation to the actions of others. It is bad when it blocks expressions of his feelings, when it denies satisfaction to his curiosity, when it turns him away from his own problems and interests, and when it fails to provide an opportunity for him to cope with them directly, overtly, and experimentally.

Students learn from things that occur in all phases of life—in and out of school. If education is to deal with modern problems, it must shift radically from the traditional curriculum of fixed courses, fixed hours, fixed rules, and fixed objectives toward a widening pattern whose subject matter encompasses nothing less than the entire complex environment. In short, a public education that walls itself off from the most deeply felt aspects of living and concerns itself with courses and academic requirements that are the least deeply felt aspects of the student's experience is an irresponsible education. Students work most intensely at tasks in which they are motivated by their impulses, desires, and talents. To force effort upon students when they are not in the least interested and they do not feel or see any significance in what they are compelled to do, can only mean that they will probably learn far better to dislike that kind of effort than they will learn the content or skill that is the ostensible educational objective.

Proper content of curriculum is any experience that is educative. Whatever enables one to grow is important in curriculum. The well-constructed curriculum is not unlike a laboratory. It is increasingly experimental, and all its participants —teachers and students alike—are, in some fashion, staff scientists. Hence, it is necessary to avoid rigidities and requirements, absolute boundaries, mechanical standards, and frequency solutions. Just as the experimental method is flexible, exploratory, tolerant of the novel, curious to try the hitherto untried, so, too, is its educational symbol.

In summary, progressivism is the theory in practice of an American culture in the process of growing up. It is the philosophy that is liberal in character. It prides itself on tolerance, continuity, and progressive experimentation. It is a philosophical basis for work and study experience programs.

Work and Study Experience Programs in the Curriculum

In general a curriculum may include work and study experience on a job for three purposes: (1) beginning experiences early in the curriculum which serve as an occupational exploration, acquainting the student with opportunities and requirements in the field, (2) experiences in the middle and latter half of the curriculum which serve to give the student the opportunity to test theory against practice and which serve to teach skills which the institution feels are best learned on the job rather than in the academic classroom, and (3) experiences near graduation or shortly thereafter which are correctly characterized as internships prior to entry into professional practice.

With regard to the first category which may be somewhere under the classification "orientation experiences," there are few used at the university level. Here the goal is usually one of having the student explore the field and experience its requirements before undertaking the major portion of his professional course work.

The variety of programs in which agricultural economists seem to be most interested fall within the second category of "operational experiences." These are designed to teach certain skills on operational procedures which the institution does not or cannot teach. These programs give students the opportunity of testing theory against professional practice. A common reason for including such experiences is the tendency for some institutions and their faculties to prune from their offerings those courses which are deemed "vocational."

For most purposes the term "internship" is probably erroneously used in agricultural economics circles. The term properly describes the activity of the person who has completed all the academic requirements for admission to a profession but who must undergo a period of occupational experience in the profession prior to his "certification" as a recognized practitioner. Thus, the internship occurs either just prior to graduation and the receipt of the degree, or where licensing examinations are given, after a period of satisfactory experience. The internship is designed as a transition to professional practice wherein the neophyte applies learning theory to actual practice, adapting himself to the demands of the employer and fellow employees. The intern also experiences the conditions of practice and usually learns some operational skills not taught in the academic classroom. The distinction between an intern and a co-op student is subtle but important because it affects matters such as placement, supervision and timing of the experience, and credit-pay decisions. The intern is one who is master of the basic academic content of his profession and who has been screened for entry into the profession. He is treated, during the internship, as a member of the profession albeit as a beginner. He serves his internship under the direct supervision of a practicing member of the profession. For years, of course, it has been customary for a university student involved in teacher-education to "intern" as a student teacher as part of the regular curricular program. The word "internship" is most likely understood in the context of the requirements to become a medical doctor.

On the other hand, the cooperative student is a student employee who is learning part of the procedures of the profession on the job and is supervised by senior employees or unit supervisors. From the cooperative student's experience comes not acceptance by the profession, but increased skills and knowledges of the job, a better understanding of actual practice, and, hopefully, a motivation for increased performance back on the campus—a background which can sharpen classroom questioning and discussion and produce a more insightful self-understanding of strengths and weaknesses.

Summary of Programs Offered

Scope

Programs included in the analysis are those using a work experience oriented environment to produce desirable education outcomes. While all work is educational in some context, those students who work during the summer or at any time during their college education in jobs which they secured for themselves and which have no connection to the university except that they may have gotten a job through the university's placement service are excluded from consideration. Included in the analysis is the full range of work programs that are college or university sponsored to the extent that they are considered an important component of the curricular program. Also included are the so-called co-op education programs for which no academic credit is given. Any work-related program for which academic credit is given is included.

Usage

In April 1974 questionnaires were sent to 54 state supported universities offering a four-year undergraduate program leading to a Bachelor of Science degree with a major in Agricultural Economics and/or Agricultural Business Management.[1] Forty-seven universities responded for an 87 percent rate. To the question, "Is it possible for an undergraduate student to receive academic credit for participating in an off-campus activity that includes a work and/or study experience with or without pay?" 30 or about two-thirds of the total respondents answered "yes." Two others indicated that a program would begin in the fall semester, 1974. To a second question, "Is it possible for an undergraduate student to engage in an off-campus work experience organized by the university (other than usual placement office services) related to his major academic interest with pay but without credit?" 18 (38 percent) responded with a "yes" answer. Three others indicated that a new program would begin soon.

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[1] These were the major land grant universities in each state plus California Polytechnic State University, Texas Tech University, Southern Illinois University, and West Texas State University.

Names given to the programs include the following: Agricultural Business Internship, Agricultural Internship, Summer Internship, Management Training Internship, Co-op Study, Traineeships, Internship in Agribusiness, Outreach, Youth for Action, Supervised Practice, Work-Learn Program, Work-Experience, Field Study, and Coordinative Internship. Excluding the nine universities who answered "no" to both initial questions, only one of the remaining 38 indicated that they plan to contract or reduce activity in their programs in the next five years; one other indicated the matter was uncertain, five indicated they intended to continue the level of activity in the programs as it is now, while the rest replied that they intended to expand their programs of this kind in the next five years. This substantiates a current high level of interest among agricultural economists in work-study programs and a general resolve to increase their use in the future.

Participation and duration

Twenty-six departments reported a total student participation of 480 in the past three years or an average of 160 per year. The range on a per-year basis was one to 24 with an average participation of six. Program durations varied from six weeks to a full semester of 16 weeks. The average was 11 weeks. Five departments reported an average program duration of 16 weeks, indicative of utilizing a full semester. Fifteen other departments reported either a 10 or 12 week average program duration. One on a full co-op program reported 32.

Program availability

Sixteen departments opened their program only to juniors and seniors while 10 others said their program was available to lower division students as well. However, three of these would not accept freshman students in the program.

Credit awarded

Credit awarded per experience to students averaged six quarter hours for those students participating in the past three years. One department reported a 16-week program for which 20 quarter hours of credit was awarded. Another department indicated a new program under way that would give a similar credit award. However, the majority of departments awarded between three and six quarter hours of credit per program experience. Minimum credit awards per experience averaged 3.4 quarter hours with a range from 0–15. With regard to the maximum allowed per experience, departments reported an average of nine quarter hours with a range of three to 20. When asked about the maximum hours of credit allowed within a total Bachelor of Science degree program, an average of 12 quarter hours with a range of 4 to 24 was reported.

Basis for credit awarded.—Half of the departments indicated that the academic credit awarded was a function positively associated with the time spent in the program. Of the group, 17 indicated that the quality and/or amount of reports filed by the student was also a variable influencing the amount of credit awarded. A general rule seemed to be that one credit was awarded for about each two weeks of experience in the field. Eighty-five percent indicated that a final report was required of the student. Two departments indicated there was no final report required, and one indicated that it was at the discretion of the adviser. In terms of frequency of reports required from the student, 16 of the 26 required only an end-of-program report; four required weekly reports, two required monthly reports, and four required intermediate reports based on the discretion of the adviser.

With regard to the question of who provided the transportation for the student to and from the program, 21 of 26 reported that the student was responsible for his own transportation while three indicated that the business or agency paid, while two others indicated a sharing of this responsibility.

Benefits Accruing from Work and Study Experience Programs

Answers regarding program benefits were given by faculty who were asked to reflect what students and cooperators thought were benefits. However, it is difficult to make such responses without introducing some personal bias.

Benefits to the student

The question was asked, "According to student participants, what are the major benefits accruing to them?" The answers to this question were stated in a number of ways. The most frequent response had to do with the gaining of real world experience, the opportunity to seek economics in action, and the insight gained into the problems of an actual manager. The terms "hands on learning" and "relevant education" were other ways of expressing this merit. Some said it gave them the opportunity to learn how a business works. Some noted that this experience component was very helpful in preparing their resume. These kinds of ideas were mentioned as reasons from 22 of the respondents or about two thirds of the respondents.

The next group of benefits mentioned by nine respondents had to do with the improvement in the appreciation of academic courses when the student returned to the campus. The students said their view was improved because they had the opportunity to observe relevance of the courses to the work world. An improved view of the applicability and relatedness of classes to the real world was another way of expressing this idea. An equal number of respondents said the students indicated that the opportunity for a job and the opportunity to earn money was of equal importance.

In addition to these two major sets of advantages as expressed by the students, there were a number of others which include the following: an improved self-confidence, an improved perspective of a job in the area of one's interest, and contacts or expanded job opportunities. One respondent observed that 80 percent of work-study students were offered jobs by the business or agency with which they had the experience. Others included vocational experimentation, the chance to test the application and usefulness of their knowledge, a better idea of what jobs are like and a better idea of what education is needed, a chance to get away from the campus, academic credit, and opportunity to make decisions, to learn to assume responsibility, to develop skills in defining problems and applying academic knowledge, to work with people, and that the experience created an awareness that they were not ready for top level management merely because they had completed a Bachelor's degree.

Disadvantages

While the vast majority of students report a great deal of satisfaction, some disadvantages were reported. Some question the program value for other than an orientation program. Others report they were used too much as a "hired hand" and learned very little about management decision making. These disadvantages would likely disappear with proper pre-experience communication among the student, cooperator, and university supervisor so that there is a clear understanding of what is expected of each other.

Summary

In summary, the merits reported by agricultural economics students reported are consistent with other studies [6]. Basically, they include the following: (1) students find greater meaning in their studies as theory and practice are more closely related; (2) the coordinating of work and study increases student motivation via seeing connections between the jobs they hold and the things they are learning on the campus, thus resulting in greater interest in academic work; (3) for many, work experience contributes to a greater sense of responsibility for their own efforts, greater dependence on their own judgments, and a corresponding development of maturity; (4) because the experience involves the students in relations with co-workers who come from a variety of backgrounds, and because success in these jobs requires constructive relationships with colleagues, most students develop greater understanding of other people and greater skills in human relations; and (5) programs help markedly to orient students to the world of work.

Benefits accruing to the business or agency

The question was asked, "According to business and government agency participants, what are the major benefits accruing to them?" By far the most overwhelming benefit mentioned by 20 of the respondents was that it gave the business or agency a chance to look over a prospective employee without any obligation. This tended to be helpful to their recruitment program. A second major category of benefits had to do with public relations with the community and the university. Some felt that it gave them a progressive image and considerable public relations value with potential employees. One mentioned that it promoted the company and gave the company visibility as the student returned to his campus after his experience and shared a good feeling about the company with his fellow students. Other reasons include the following: to get a fresh look at a particular job, a chance to get better acquainted with university programs, a chance to get better acquainted with student capabilities, a useful input in designing management development programs, an aid in establishing criteria for recruiting purposes, a chance to understand new employee motivational factors, a chance to get valuable suggestions from the student's final report with regard to company problems, and that the students sometimes provided a contribution far greater than the wage for which they were paid. Another important factor mentioned was that it reduced training time for new employees if they hired the student who had just completed the program. Some companies felt that the source of seasonal help of rather high quality was a significant benefit.

These advantages to the business or agency are also consistent with other studies. Benefits may be summarized as follows: (1) a mutually important industry-college relationship is enhanced, (2) the student serves as a "goodwill ambassador" for the cooperator with faculty and students upon return to the campus, (3) the infusion of fresh young people from an educational environment can provide new ideas and view points which can be refreshing, stimulating, and helpful, (4) the program can be an excellent source of temporary manpower, and (5) cooperators can look over potential employees without obligation, and if they eventually hire the student, less cost and time is required for in-service type training.

Benefits to the university

The respondents were asked, "What are the benefits accruing to the university?" The most frequently mentioned benefit (10 times) was that it was good public relations with business firms and the general community. Mentioned an equal number of times was that it offered an opportunity to broaden the base of educational offerings, including facilities, available to students and contributed an effective teaching method which was not available on campus. Six mentioned that it gave better working relationships with industry while five noted that it resulted in better motivated students and less "senioritis." Five respondents indicated that it provided case material for the classroom and was helpful in providing classroom feedback both with regard to particular courses and to how well "we are doing" with regard to the total curricula. Seven noted that the placement of students was easier if they had participated in such a program. Other reasons mentioned one or two times included: happier students, that it convinces students that the university is really interested in their education and that the university understands the importance of the work world in education which tends to reduce the "ivory tower" concept of professors and university people, faculty learned something about the real world, variety in curriculum, research input data and better research cooperation with industry, an aid in student recruitment, an aid in extension programs in agribusiness, more college support from agribusiness, and a source of speakers for campus activities.

Again, these are consistent with findings of other studies; (1) the establishment of a relationship with the cooperators can reduce the "isolationism" of the college and result in a better rapport with the commercial community, (2) classrooms are stimulated by the feedback students who have participated provide, (3) the base of facilities the university can offer is broadened—often the student gets a chance to use specialized equipment not available on campus, (4) placement of students becomes much easier, (5) fund raising activities are often aided substantially as cooperators become more willing to support research, give scholarships, provide campus speakers, and provide data for projects, and (6) recruitment of students is enhanced as students are attracted to universities having such programs.

Operational Formats for Program Implementation

It is important that a written operational format be evolved for the implementation work and study experience programs even though details will necessarily vary among departments. Based on the responses received by the survey and the author's experiences, the format should include:

I. *Set of Guidelines for Distribution to Students and Cooperators*

For general student distribution and to cooperating agencies, a set of guidelines should be developed to inform the student about the programs available, how to go about applying for participation, and the program requirements. The guidelines should include:

1. A statement of the objectives of the program.
2. A statement of the requirements and regulations of the program to include:
   a. Who is eligible.
   b. What is the minimum grade point average (if any) necessary.
   c. What is the minimum and maximum credit allowed per experience and within the total B.S. degree requirements.

   d. A statement regarding stipends.
   e. A statement of the various alternative programs available (if more than one).
   f. A statement detailing nature of memorandum of agreement required.
   g. A statement concerning the reports required and the grading procedure used.
   h. How and when to apply.
   i. A statement of student responsibilities in regard to housing, transportation, board, insurance, and liability.
3. A statement regarding the responsibilities of the cooperator and the university.

II. *Student Application*

It is recommended that interested students be required to complete a formal application. This will insure that serious and sufficient thought has been given to the matter. The application should include:

1. Name, campus address, and telephone number.
2. Option in which enrolled for degree.
3. Name of faculty advisor.
4. Credits earned to date.
5. Grade point average by semesters and cumulative.
6. Time available to devote to work-study—number of weeks and desired period.
7. Statement as to "why you want to participate" in program.
8. Financial resources available to expend on the program or, alternatively, level of stipend needed in order to participate.
9. Desires as to type of cooperator and nature of experience.
10. Language proficiencies (if applying for international program).
11. Statement of previous practical experience.

III. *Memorandum of Agreement*

Of 27 departments reporting the use or planned use of work-study programs, 13 use no formal agreement. Ten used a three-party agreement (student-university-cooperator) while two used a two-party agreement. Of the latter, one was between the student and the university while the other was between the student and the cooperator. Two others planned to evolve formal agreements. This author strongly recommends the use of three-party agreements to formalize communication and responsibility among the parties reducing the incidence of unsatisfactory experiences due to misunderstanding and to demonstrate to the student participant that such agreements represent good business practice.

The memorandum of agreement should include the following:

1. Name, home address, and phone number of student.
2. Name of cooperating business or agency and address.
3. Name of cooperator's representative responsible and business telephone number.
4. Name of university faculty member responsible and telephone number.
5. Duration of the program and working hours.
6. Stipend to be received by participant.
7. Detailed nature of actual duties to be performed by student—attached as appendix to agreement.
8. Nature of student's responsibility as to travel to and from location of cooperator, housing, board, and insurance.
9. Course in which to enroll at the university.
10. Amount of academic credit to be awarded upon successful completion.
11. Nature and frequency of reports to be filed by the participant with the cooperator and with the university.
12. Evaluation report responsibility.
13. Signatures of student, university representative authorized, and cooperator.

IV. *University Liability Statement*

These statements should be worked out in cooperation with the university's attorney and details will vary from state to state. Basically, the statement releases the university from responsibility of accidents or death of the student while engaged in the work-study program.

V. *Required Reports*

A format of the reports required by the student for submission to the faculty representative should be developed. This will assure consistency and equitable treatment of student participants. It may include:

1. Student's name and mailing address.
2. Cooperator's name and address.
3. Period covered by report.
4. Summary of new knowledge gained and experiences since previous report.
5. Space for problems encountered, suggestions, etc.

6. Student's signature with date sent to cooperator's supervisor and university.

VI. *Evaluation Reports*

To assure continued improvement, an evaluation at the end of each program is absolutely necessary. Independently, the student, the cooperator, and the faculty representative must take time to evaluate the program. The university and cooperator should also evaluate the student. The format for each will vary somewhat.

For the cooperator, what rating would he give to the student on a number of characteristics that could include ability to learn, interest in learning, speed of completing responsibilities, willingness to receive guidance, relationships with other employees, dependability and reliability, ability to perform without supervision, judgment, personal appearance, enthusiasm, courtesy, overall performance? Additionally, the cooperator might be asked: Did the student earn the stipend paid? What characteristics did you like best about the student? Least? In what ways does the student need to improve himself? What overall rating do you give to this student's program? What recommendations do you have for the university to improve it? What benefits accrued to you as a cooperator?

For the student, give yourself a rating on personal characteristics (use the same list as used by the cooperator). Also, what were the benefits you received from the program? Would you recommend a similar experience to other students? Do you feel university credit is justified for the program? Why or why not? What is your overall evaluation of the experience?

The faculty representative should, in addition to evaluating the student for grading purposes, be asked what particular benefits does he feel accrued to the university from arranging the program, does he fell the university should continue to work with the cooperator, the strong and weak points of the program, and suggestions for improvement.

Summary

Of 54 state universities surveyed, about two thirds offered the opportunity for a work-study experience program off-campus for academic credit and/or pay. Interest in complementing the formal classroom and laboratory setting on-campus with such off-campus programs is rising, and most departments plan to expand the program. Objectives of such programs are stated in numerous ways but basically include:

1. To offer students an additional approach to learning and teaching by integrating classroom theory with employment experience in the practical world of decision making.
2. To give students the opportunity to explore their own interests in vocational fields.
3. To provide additional motivation for courses given on campus.
4. To serve to increase the student's understanding of the application of scientific principles and management techniques.
5. To give students an appreciation of the relationship between formal education and job success, thereby increasing their self-confidence, maturity, and sense of responsibility.
6. To enhance the relationship between the university and the employers of its products (graduates) as regards the university's ability to monitor its academic offerings, and receive increased support for research and extension.

As a vehicle for implementation, a special course is designated with variable credit.[2] Course titles vary widely. A formalized three-party memorandum of agreement is recommended. The emphasis on work experience versus emphasis on study experience will vary for individual students and the desires of cooperators. Most subscribe to the notion of an inverse relationship between credit given and stipend received which is typically similar to the idea of credit awarded and degree to which program is "work only" related. Another way of expressing it is if the cooperator utilizes the student to do a particular job that replaces the cooperator's need to hire another person, there is likely a higher stipend paid and less credit awarded. However, if the student has the opportunity to study the cooperator's business by moving among departments and/or researching a problem, the student should likely receive less pay and more credit. In some instances, the student may be nearly a total liability to the cooperator as measured by his output of directly productive work.

The mode of operation seems to be a maximum award of one credit for each two weeks of experience and the total should not exceed 8–10 percent of total B.S. degree requirements.

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[2] Some universities offer an additional seminar class for credit for students who have completed their off-campus programs; there is additional learning from the sharing of experiences among students.

There are no significant disadvantages to any party from the offering of work-study programs. However, there are definitely benefits to all participants. There is difference of opinion as to whether such programs are of higher or lower cost to the university per credit hour of instruction. Some argue it is higher because each program is typically prepared for only one individual. Others argue it is lower because it utilizes facilities off-campus. Partly, it depends on the extent to which campus facilities are at capacity. While programs are being initiated, the university must appreciate the significant gear-up time required and give adequate time and reward to the faculty involved. In early stages of development, there seems little doubt costs are higher. Funds are needed so that the faculty member can make initial visits to potential cooperators. For internationally-oriented programs, this cost is considerably higher.[3] The public relations value of such programs with the tax paying public is of considerable value. Happier and better motivated students provide an important bonus for being involved. The minds of the majority of educators likely embrace many tenets of the progressivist educational philosophy, and work-study programs are likely to receive majority support of faculties if credit awarded is not pushed out of the 8–10 percent range. For the 1970s, it seems like the "way to go" to be "up-to-date." But it is really an "old" idea with "new" support.

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[3] Space does not allow discussion of internationally-oriented programs. An unpublished paper entitled "An International Dimension in Undergraduate Curricular Programs in Agriculture" is available from the author on request.

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Selected Alternative Programs for Bringing the Real World to the Undergraduate Classroom*

CHARLES E. FRENCH

THIS SESSION assumes that undergraduates need exposure to the real world. To be honest, I am not uptight about that need. Good education mandates relevance. But relevant education involves much more than most of the "real world" discussions I hear. Affluence means more than material goods. If education is to add appropriately to our affluence, it must conceive of the real world as a many-splendored thing. Actually, the topic of relevance begs for priority in my remarks, but discipline will keep me primarily on my assignment.

Professor Snodgrass has done well in laying out some philosophy and history bearing on "real worldism" [36]. He has blueprinted well the student intern and co-op plans. Where he examined taking the students to the real world, I will examine bringing the real world to the students. I will say a bit about preparing a student to be a prepared realistic citizen—a relevant student, if you will. I will try to cover alternative programs of: games and simulators, particularly computer-based ones; computer assisted instruction (CAI) and such modern computer applications; programmed learning and audio-tutorial methods; case studies; class visitations and selected audio-visual techniques; field trips; special problems, projects and theses; and a few miscellaneous approaches to realism. Admittedly, use of these techniques may not be synonymous with giving student relevance, but the association is close.

Making Students Relevant

Relevance is defined primarily by the beholder. If I had a text for this paper, it would be "Learning to Be," taken from the great UNESCO study of that name [11].[1] Learning must be universal and without time. The relevant student has been taught how to continue to learn with others throughout his lifetime.

I am patently unimpressed with the product specifications for recruiting undergraduates laid out by many employers. Usually the employer wants a student with a list of personal, professional, and environmental characteristics never embodied in one young person. Professor and employer are both ill-advised to expect a student to be all things to all people.

An information matrix of employer and professor information relative to placement and training was designed (Fig. 1). This is not to design university curriculum or industry training programs, but regardless of which "real worldism" alternative is chosen, some issues stand out. First, even if Figure 1 exhausted the relevant items known by both parties, each has plenty to bring to bear on student placement (and training). Second, professor and employer must each stick to those items he knows best. Third, the professor's advantage lies in educating the student rather than in serving as an educational attaché for the student in the real world by someone not professing to be a teacher. Professors know more about education than employers. Fourth, the imprint of the good teacher is usually a mixture of personal and professional. Even if a professor had four years with any given student, it would be a short time to transmit such elements of good education. In fact, my main argument for methods improvement is to gain efficiency so students can get more of the personal and professional tone of the professor. Fifth, the university is a minicosmos of these professor-type things, and four years is inadequate exposure of students to the "real world" of a good university. Sixth, the uniqueness needed for the first job is obviously in the comparative advantage of the employer. The public has no reason to pay for this training. Seventh, many general items expected by the employer of the student can be taught best by the professor. Eighth, a good university can afford the

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[1] References are indicated by numbers in brackets and refer to that item in the reference list. I have not referenced all the many seminars, workshops and such, but I was impressed with the University of Florida workshop [41]. My priority reading assignments for this paper are *Learning to Be* [11] and *The Fourth Revolution* [3].

What Average Employer *Knows*

1. In-depth knowledge of what makes his organization tick.
2. Type of man that has advanced in his organization.
3. What the University was like when he was in school.
4. Possibly which schools are doing a good job now.
5. Discipline of meeting short-term deadlines.
6. Value of knowing at least a minimum amount about a lot of things.
7. Value of common sense.
8. Value of organizational political know-how.
9. How to obtain a limited set of objectives.
10. Value of organizational loyalty.
11. The differences between line and staff responsibilities.
12. What effect outside forces have on his organization.

What Average Professor *Knows*

1. Superficial knowledge of what makes many organizations tick.
2. What types of men have advanced in organizations generally.
3. Educational philosophy, objectives, techniques and methods.
4. Some reasonable valuation of several schools.
5. Rigor and value of scientific analysis.
6. The power and limitations of generalizations.
7. The latest in techniques of analysis.
8. The discipline and humility of subject matter specialization.
9. The macro setting of many organizations.
10. The richness of new ideas generated in the luxury of non-partisanism.
11. How to work for many bosses.
12. The luxury of worrying about the long run.

What Average Employer *Does Not Know*

1. The sophistication of university personnel evaluation and knowledge.
2. Neither the general high level, nor the range in potential of students.
3. The flexibility and adaptability of well-trained students.
4. What other organizations are doing generally and specifically about personnel choice and management.
5. The latest in technique of analysis.
6. The long-run planning process.

What Average Professor *Does Not Know*

1. How to place his students.
2. What students are really getting in the University outside the professor's area.
3. Up-to-date organization technology and changes.
4. How to make concepts and tools operational.
5. Industry politics and unique employee constraints and opportunities.
6. The short-run necessities and expediencies of modern organizations.

Figure 1. An incomplete, illustrative, informative matrix for employers and professors dealing in agricultural economics undergraduate placement (and training)

variety needed of such things as ideas, research, technology, and philosophy because it can spread the cost of these over many students. Typically an organization cannot. Ninth, any professor worth his salt has enough knowledge to motivate and excite students for the short time he has them. Tenth, any university worth its salt has enough excitement to compete in learning with any outside organization.

Alternatives for Bringing in "Real Worldism" to the Class

This section emphasizes sophisticated tools and techniques. Let me preface it by saying that these are not the only ways to get such realism. Bob Taylor puts it this way:

> . . . The easiest technique that the professor can use to bring relevance to the classroom is to sprinkle his lectures liberally with up-to-date examples from the world. One principle and seven examples is about the right ratio. Every time that the students ask about this again always bring up a new example. This is a technique for bringing relevance to the classroom and for building motivation that can be done by each professor without a great outlay of expense or time-consuming materials. [personal communication]

Games and simulators [10, 5, 26, 14]

Let us acknowledge that all computer and analytical methods are not games and simulators. Also, all games and simulators need not be computer-based. Buying and selling problems in prices courses, auctioning off an unknown number of candy bars to establish a demand curve, and commodity games in marketing courses are examples. These can be complicated or simple. For example, consider a farm management game to teach tenant and landlord bargaining and contract preparation. Part of the students are given characteristics of a tenant. Others are given characteristics of a landlord. They are graded on their selection of a partner and validity of their contract. The clincher is that there is half again as many tenants as landlords and those who cannot make a deal presumably fail the exercise! This game does not need a computer to get motivation.

Babb describes a management game as "a dynamic case study" [10]. He illustrates it as a model representing an organization or part of an organization usually in a competitive environment where subjects manipulate decision variables to achieve objectives as illustrated in Figure 2.

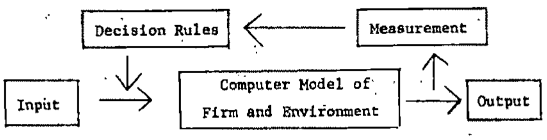

Figure 2. Diagram of a management game

Source: [10].

Not all games are management oriented, but Babb lays out what can be taught with such games.

> Management games are quite flexible in terms of what can be taught. They have been used to teach basic management concepts such as planning, control, organization and coordination. They can be used to demonstrate economic principles and are especially effective in the area of imperfect competition where we can say less about behavior and performance. They can be used as an exercise to gain practice in the use of analytical tools such as sales forecasting techniques, cash budgets, profit-volume analysis, ratios, investment analysis and the like. They can be used to demonstrate the strengths and weaknesses of various organizational schemes and to improve human relation skills. They can be used to teach a subject his role in and contribution to a complex organization and to give him a view of the way the parts fit together. . . . Last, games have been used to teach subjects about organizations with which they deal so they can be more effective with them. [10]

Simulation differs from games as defined by Babb and Eisgruber:

> . . . mathematical models differ from simulation models—the first are error-free (analytic), while the latter are non-error-free (non-analytic). That is to say, simulation refers to a formalized system where the rules of validation require a sampling of the relevant entities.
>
> In business games, the process of simulation is periodically interrupted, and the human decision-maker (or decision-making team) modifies earlier decisions in the light of new knowledge gained from results of earlier decisions. [5, pp. 15–16]

I will not belabor the place of games and simulators. They are only on the threshold of their potential. They are proved, available, flexible, and motivational. They can be made realistic; the many lay people who have played them have affirmed this repeatedly. Computer games and simulators are bringing "real worldism" to the classroom just as they have brought "real worldism" to the real world. In that difficult area of behavior, they probably have no teaching peer.

Simulation has great conceptual strength for "real worldism." Public professional education was to prepare people for the real world. It was a bold, expensive simulation. By conceptual standards, the historical form of education is woefully inefficient as compared with simulation.

Computer Assisted Instruction (CAI) [2, 37]

The grand application of CAI staggers the imagination. Its potential has long been accepted. Its cost has been the problem [2], and cost will continue to preclude its availability in many places, but needed applications are possible without a total campus CAI setup. Once a campus system is installed, like the great Plato system at Illinois [2], the agricultural economist can no longer avoid trying CAI. Glenn Himes and associates at Ohio State are to be commended for getting started [15]. They received a windfall from their extensive medical school applications. I also understand that Kendrick at Nebraska, Gorman and Capener at New Mexico, and people at Georgia and Florida are working with CAI. Most applications in agricultural economics are in simple material and usually in only a portion of a course. We will build up. The diagnostic potential staggers the imagination. We should look specifically at our statistics courses [38]. The variety of fallouts will be exciting. For example, Ohio State is setting up a bank of up to 4,000 examination questions where an instructor can construct and print-out tests giving information on when the question was last used, how the students did on it, and such. Student reviews from such a system are obvious.

CAI is gaining in large systems such as in California [23] and New York. It fits high cost areas, such as medical diagnostic work. The analogy is clear for many of our courses, especially management. It has potential for nearly any case study setting. Integrative issues of our discipline provide fertile ground for experimentation.

Systems such as the Ohio State medical programs allow adaptation for on-the-job training such as for paramedics. Scheduling groups away from duty stations was a problem which the hospital could not handle. The individualized nature of CAI allows such training to be scheduled into daily routine.

Development of computer-based information retrieval systems captures the mind of any scholar. Corollary uses of information retrieval systems and CAI are myriad. Research, CES, and teaching interactions mandate serious experimentation here.

Alpert and Bitzer [2] discussed three misconceptions about CAI. One is that "since the instructional strategy must be previously programmed on the computer, it must of necessity anticipate all conceivable student responses so as to compare them with 'correct' answers stored in the machine." They claim that "teaching strategies which do not call for specified student responses are widely used and often of greater value in many fields and at many levels of instruction." We do not have all the answers in any system. Our teachers now believe that their goal is learning with the student as contrasted to teaching him. They have no trouble relishing this open-end aspect of CAI. Anyway, completely self-centered systems could be stifling. Remember Professor Galbraith's defense of a bit of ambiguity, "Had the Bible been written in clear, straightforward, noncontradictory lanquage and had the language been constantly modernized to accord with contemporary tastes, it would, almost certainly, have been, or have become, a work of little influence" [12]. CAI is systematic and additive and has advantages over many historic ways professors try to improve their courses.

Another misconception is that "computer-based instruction may be useful for the transfer of information, but it is not of value in the development of critical thinking" [2]. Alpert and Bitzer contend that "computer-based instruction has often been found to be more effective than standard educational procedures in many learning situations that call for judgment, interpretation of complex problems, and evaluation by the student of the validity of his conjectures. . . . Obviously we have proceeded far beyond the role of the computer as a bookkeeper, scorekeeper and guide to selected textual material." Heuristic developments with the computer emphasize this notion.

Third, they challenge the misconception that "a computer system used for computer-based education cannot be used in a time-sharing mode for conventional computer programming." They can be casual about this with the multi-millions that NSF dedicated to the University of Illinois specifically for CAI. But the versatility of hardware is staggering and growing. Many are agreed that successful student-computer interaction depends upon proximity and quick turnaround. CAI has both. We have time for the hardware to catch up while we are checking out a wide range of simple experiments with CAI.

This CAI discussion is superficial. Coverage of such innovations is not easy to define. For example, classroom use of such techniques as the touch-tone telephone is important but not really CAI [17]. We must follow applications in many areas. Elementary principles teaching offers widespread use. Chemistry [32], mathematics, possibly English grammar, and spelling may be revolutionized. We should watch for CAI developments in areas of high cost intensive education such as medicine and law [13].

Programmed Learning and Audio-Tutorial Methods [39, 28, 40, 27, 22, 4, 20, 30]

My selection of techniques here is only illustrative. Programmed learning has undergone the traditional and often lethal partisan conflict. Educators and psychologists have filled many journals about it. The excitement was with the system of the approach. The ideas have been felt in many multi-media approaches, and they live on although not named so specifically as before. The specific applications have been somewhat simple and probably more adapted to elementary than to higher education. The ideas are sound and one should understand their background to understand many of the current developments.

Alpert and Bitzer [2] question a misconception that "computer-based education is synonymous with programmed instruction." They hold that "computer-based education makes possible unprogrammed instruction or student-controlled learning by utilizing teaching strategies which differ completely from the basic tutorial logic of most programmed instruction. While of substantial value for the development of certain skills, the interchange of factual information between man and computer is only one mode whereby a teaching strategy may be incorporated into the computer."

This Association looked at audio-tutorial methods. A let-down and lapse can often follow a flash beginning. It is now time for reassessment. So many first courses have been put on audio-tutorial that some universities have been getting student resentment. They like some, but they want variety, particularly in their first year.

Programmed and individualized methods can bring great realism to classroom or laboratory. They personalize realism. They force rigor in the presentation [39]. The ideas are sound, but expensive and possibly prohibitive if one thinks he must program the whole curriculum. We must be selective. We must consider these techniques for at least sections of our principles courses. Many small loops have a place. Kendrick *et al.* at Nebraska have a large library of the most often asked questions where students can listen to the answers repeatedly and face no instructor wrath. The answer is better thought through than most oral answers. Taylor and Bohl at Purdue have loops on general interests topics outside their office so waiting students can dial in and learn while they wait. These are simple applications, but the start is made. The approaches are a natural for prerequisite material.

Audio-tutorial material in a Purdue farm management short course was often taken home for Dad to study. We have the potential for CES applications. All one needs do is look at the subscription services available to professionals for cassettes and other self-study aids. Some are showing up in the agriculture.

Case studies [24]

Three types of cases have evolved: Business School (Harvard), Law School, Agricultural School (farm management). Type chosen and use made should depend upon teaching objective.

The Business School case ("Here is a situation, what do you do?") has been effective. Its elite lineage gave it widespread use often without questioning its objectives. It had original objectives which may not fit our classes today. One objective was the fostering of student interaction and learning from probably the most expensively recruited, most systematically diversified, and most brilliant group of students ever assembled. These students personally brought great realism to the classroom. The trick was to render and distill it. Another objective was to teach about macro settings of problems, often as known by the students. Another objective was to allow the professor a teaching advantage because he was imbued with great personal knowledge of the case. These unique characteristics raise questions about wholesale use of the case by us.

Eric Oesterle at Purdue holds that two types of management cases work. One is a short, incident type case which reinforces a specific point or principle. It is short enough that students read it. The other is a detailed, well-documented case which students are forced to read, but which impresses them with what facts and good analysis can give. Further, Oesterle's classes are briefed on current status of the institutions in the case by an assigned group in the class. He believes in a resource person from the company or for the area, if an area such as antitrust or taxation is being studied. In person or by tele-lecture, this is a resource person, not a lecturer.

The Business School case is often borrowed. An agricultural economist who borrows such a case must evaluate it correctly in terms of his course. Many such cases are probably too inefficient and beyond our teachers and students. The answer is said to be development of cases of this type which are agriculturally related. This is expensive and must be compared against alternatives.

The Law School case ("Two sides of this question exist, find them, and practice upholding each.") is a somewhat more limited case. Its use is widespread, but its evaluation among law faculties is not all positive. Admittedly, it is used more for student practice than for bringing in realism. Obviously, the better the instructor, the more realism.

Issues of contrast or adversary can be handled in our classes with this type of case. Pricing and marketing, policy, and group decision courses are obvious candidates. Our students are often too partisan; forcing both sides of an issue could enrich our programs. It might also force professors to be more objective! Most of us resist outright acceptance of the idea that we should teach communications. But "taking first one and then the other side" in an adversary role is a technique which will give some good communications training.

The Agriculture School case ("Here is a real situation [analytical framework]. Let's make these assumptions. Now what will happen [partial analysis]?") The main objective is analysis, but we are teaching such within a real life setting. At times we may also be teaching subject matter with the case, but that objective should be explicit. To be most effective, each case must be placed in its proper perspective in the real world.

Our people differ on techniques to buttress case analysis. Some still feel that you need depth layman input by field trips or class visitation. Backup data, economic history, and colored slides may accompany the case. All should be sequenced into the partial analysis.

Cases demand good, and possibly experienced and unique, instructors. Cases must prove their worth for a given situation—their honeymoon is over. Cases will not prevent instructor bias; they in fact may have a weakness here. Cases are often expensive. Cases are not automatically relevant. A joint relationship of a case and the computer (or other techniques) is the promising way. Cases are abundant; a systematic clearing house for agriculture cases would add realism. Cases must provide for student interpretation and improvement. Contrasting cases can be effective. Case realism depends on many things. One of the most important is the professor's understanding of the case.

The case will probably continue for some time to be the most effective way to bring realism to agricultural economics courses for many professors. Cases probably fit many simple applications in smaller, less endowed departments or those which do not have large undergraduate enrollment. The best departments will use cases, but the cases will become more sophisticated, technologically efficient, and better integrated into the specific objectives of the courses. Professors may also wish to remember that they, as well as their courses, are often viewed by students as a series of case studies!

Class visitation and selected audio-visual techniques

This category is heterogeneous. My brevity will undoubtedly render disservice to some techniques.

One of our instructors feels class visitation is a necessary transition as we move from field trips to improved technology. He likes a 50 to 90 minute, eyeball-to-eyeball contact by student and manager. To encourage this, he refuses to answer any questions about the case after the visitor leaves. Others argue that you do not need that much time and it is often impossible. They feel the eyeball thing is exaggerated. I expect technology will win out in the end, but we may not be there yet in detailed subtle cases.

A case situation is almost always needed for a good class visitation. We say, "Never let a visitor lecture—control the interview, or better yet, let the students do so." The old "visiting fireman" does not even deserve discussion.

The tele-lecture is effective, especially for illustration of a single point. Many are using it [18]. It is probably limited for analysis. It can open up discussions, but the instructor must know the personality interviewed and the situation well enough to handle questions once the interviewee is gone. Multiple interviews of 10–15 minutes, often with contrast, are most used. This technique needs wider use, and your telephone company representative can assist you.

Video tape is increasing in use for short illustrations It can complement the class visitation and/or tele-lecture. The large film may be too expensive, so applications should probably be thought of as small and well selected. Film generally has great obsolescence (or at least it should have). Slides well done have flexibility and costs can be reasonable. Slides are effective for handling seasonal sequence problems. Also, contrast is quick and effective. Quality is the key to slides or other realism supplements. Aerial pictures, for example, are now reasonable and can supplement ground level slides in resources planning, farm management, and appraisal courses.

Techniques in this group are dependent upon the imagination of the professor. Also, we need greater availability of technical preparation. Preplanning for each is important. Most of these are proved, flexible, and realistic.

Field trips

Field trips are nearly obsolete because technology of film and electronics has outstripped the efficiency of transportation and logistics. Not everyone agrees; for example, Bud Stanton of Cornell wrote,

> . . . We still believe that field trips are the best way to teach farm appraisal and farm management. It is increasingly expensive, but the student response in field is a very important part of the learning process. In marketing we have phased-out fields trips and brought managers of businesses to the classroom believing that work experience and case studies are a better way to get some sense of management and real world problems.

I still think they are obsolete. Students do not consider their time sunk and at the disposal of professors. They expect more than riding around in a bus. The professor should look at the time input he has in well-planned field trips. He should add to his cost the time cost of 100 students who are dragged across the countryside or thru the urban traffic interchange and topless night clubs. This time could buy a lot of realism elsewhere. If students want a joint social-educational jaunt to town or to the countryside, they can arrange it as a club activity. Many are doing that, and they can find industrial sponsors.

Special problems, projects, and theses

The old farm management class "home farm" problem gave realism. The concept is alive and getting exciting modifications. Students today make claims for, and are willing to give of themselves for, projects of realism. Such programs as the Peace Corps and VISTA offer this possibility. A good professor can capture this in projects or problems.

Professor Downey of Purdue has his business management students ride a sales route. The "Day With a Salesman" program is popular with salesmen and students. The student must describe the day and show how specific principles from the course did or did not relate to his day. He must evaluate the salesman with a written report to the salesman. The salesman also evaluates the student. Feedback on special projects is significant. All students do this project so it becomes an evaluation of course reality. For most students, the salesman is no longer "just a salesman."

Martin Pond of Purdue has had success involving his community development students with community leaders. Their input is used. For example, they have done interdisciplinary landscape architecture and economic planning of community facilities. Other departments reported new adaptations and interest in these devices for getting realism. The ideas are flexible and feasible.

Many students acknowledge special problem experience as their first real adult experience. They have never had the pleasure, or obligation, of being considered an expert or of being a representative of a large organization such as the university.

Cost, especially in professor time, is a problem. A cost-benefit analysis is recommended. Standardization of projects helps to focus them more directly on the specific relevant section of the course. The class project where all students go together to evaluate a problem such as the future of a local business or community institution is gaining in use. This can save instructor time. Some are using the special project as a student option, often to raise a grade. As usual, however, good students opt for the program, poor ones do not. Adults and students could work together on special projects if we would be more liberal in letting undergraduates into short-term intensive CES courses and workshops.

Some renewal of senior theses is reported. The thesis objective should be made clear. If the objective is preparatory for graduate work, opportunity cost of other material should be considered. If the objective is realism, the thesis should be planned that way. A series of varied special projects or minicourses may be more effective [29, 31].

A few miscellaneous approaches to realism

Intern or coop programs encourage "real worldism." The length of time may be varied. Many short-term, one-day-to-summer-length involvements are being tried. Better summer job placement can put students in somewhat realistic settings. This takes planning and organization of students and employers. Students are probably going to do this anyway—if it can be made more realistic, great!

Television may be an effective device for realism. But it is probably coming in for other reasons, primarily efficiency. When it is available, we can hitchhike on it as a vehicle for relevance. Relevance will probably not be a major motivator, however.

Student businesses, either in the social context of Berea or in the private context of the FFA National Farmer with three sections of land, give realism. Where the professor has such a demonstration, it is a good opportunity and challenge. Experimentation in student farms or businesses such as the Iowa State Student Farm is not on the increase.

Student work programs in departments give some students realism. Often such programs have directed students into graduate work, and this is not necessarily the most effective route to "real worldism"! Student work programs have greater potential for realism. Objectives of these programs are diverse, and planning is poor.

Alumni or other advisory boards are being used, and student involvement can give realism. The Kansas State curriculum revision project reported by Sjo *et al.* is an example [35].

Undergraduate students at Purdue enjoy a meal and learn from on-campus conference participation. The program evolved during student uprising days as a public relations thing to acquaint lay people with real live students. The exercise is now widely used and liked by students and conference people. Mostly the students interact with the conference participants at meals. Often tutorial teaching by the students evolves. Also, students can make key presentations at such conferences. Their batting average is better than that of the typical array of speakers. Their peers learn realism by observing them.

Seminar discussion courses can be an effective way to get realism. But the typical seminar with an outside person giving a lecture is not what I mean. Seminar leaders from both outside and inside can be effective if the objective of realism is explicit.

Issues of where and when to use various approaches within any individual course are important, but space in this paper precludes an in-depth discussion.

Current Use of Alternatives

In July 1974 a questionnaire was sent to 52 universities, of which 45, or 87 percent, responded. The first question was, "Are you concerned about your undergraduate students' being poorly prepared for entering the real world when they graduate"? Thirty, or 67 percent, said "We work at it and are fairly well satisfied." Thirteen, or 29 percent, said, "We work at it but do not do a good job of it." And two said, "We don't worry about it." Again I wonder if we have defined an overpowering problem.

The next question was, "If you are working at preparing your undergraduates for the real world, briefly describe the kinds of things which you do to try to get them prepared." Most reported a combination of activities, varying from institution to institution. Another question asked what proportion of the undergraduate instruction was built around each alternative. Some problems with survey definitions are obvious, but the data are helpful (Table 1).

Various departments gave such answers as: "we use teachers who know and live in the real world"; "we evaluate our curriculum often"; "we involve our students inside and outside"; "we prepare them to get and hold a job—not in the vocational school sense, but with a dedication to work, team and service in a competitive

Table 1. Use made of various techniques for bringing real world situations to undergraduate students, 52 U. S. four-year agricultural economics programs, July 1974

Real World Techniques	Percent of Depts. using the technique	Avg. proportion of undergraduate instruction built around technique among *those Depts. using* the technique*	Range in proportion of undergraduate instruction built around technique among *those Depts. using* the technique*
Computer applications of any type	98	9	3–25
Computer assisted instruction (CAI)	12	NA	NA
Programmed learning other than the computer (such as audio-tutorial systems or teaching machines)	35	4	2–20
Case Studies	90	9	3–30
Special problems & projects (with actual, significant, real life exposure)	83	8	2–25
Field trips	88	5	1–17
Class visitation (by non-academic type people)	93	7	1–40
Tele-lecture and similar approaches (with or without slide or film back up)	24	4	2–7
Slides or films (without class visitor or tele-lecture)	62	6	1–26

Other Activities Mentioned, but Proportional Use Unavailable

Counseling about real world matters
Alumni evaluations
Summer employment programs
Undergraduate club-real world activities
Undergraduate participation in university conferences
Department work by students on real world problems
Seminar thesis
Seminar & seminar courses designed in this direction
Students running their own businesses & farms

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* Some problems of definition damage these data. Some people obviously reported the proportion of courses as contrasted to the actual proportion of instruction. Where this error was obvious, the data were adjusted. Thus, the data are obviously biased upward as to the proportion of instruction so built around the technique.

environment"; "we stress *both* principles and application in courses"; "I do not think the University is a world apart from the real one"; and "we have always had 99.44 percent of our seniors employed upon graduation." My bias reads these as mild resentments about the need for "special" programs to get relevance.

Many do feel that direct attention to "real worldism" is important. Variety and widespread use of various programs speak well for our professors. However, my impression was that people in most departments were concerned more about out-of-date teaching and about failing to do as well as we know how, than from lack of ways to handle realism. Many approaches sounded old-fashioned. The small number of departments using modern tools—computers, programmed learning, tele-lectures, and such—was distressing. Comparative data in other disciplines are not easy to get, but a university-wide Purdue survey showed over 60 percent of departments using these newer, more technologically oriented approaches. One national survey showed computer use to be pervasive [1]. Given the norms I have, the results of my survey bother me. I feel that about one half dozen departments are doing a good job and the rest are not.

The computer is not synonymous with bringing "real worldism" to the classroom, but it has proved itself as a modern, efficient means of doing so. It was heartening to see that nearly all departments (98 percent) were using the computer in undergraduate work. However, only 46 percent required even one computer programming course, and only five had made even the most rudimentary applications of computer assisted instruction (CAI). Only 48 percent were using the computer to score examinations and to feed back examination analysis. About 85 percent used the computer in course and instructor evaluations. These applications are peripheral, but their limited use indicates lack of sophistication with the undergraduate program of a type probably not tolerated in research. About two-thirds indicated more computer use in graduate programs than in undergraduate programs; about one-third indicated considerably more. Essentially all reported computer use with class exercises, problems, simulations, games, and such. Yet, one-half said that very little or none of their applications involved direct student-computer interaction. Departments with computer-based problems and games reported an average of only 20 percent of their courses employing direct interaction.

Information on computer application is flowing among departments—two-thirds acknowledged getting substantial material for undergraduate computer use from other departments. One-half said that they receive valuable computer class materials from CES and AES applications. One-sixth acknowledged classroom material from staff consulting. However, about one-half said that undergraduate and CES materials in general (not just computer types) were interchanged little or none at all.

Recommendations

Take professor to real world

Professors who are tuned in to reality can bring the real world to the campus. They have demonstrated this time and time again. The efficiency of sending the professor rather than students to the real world is economically logical. Moreover, the professor must validate what he is teaching. A professor can always test his need for this by giving an open book test on some real world issues. Industry supported short-term exposures of professors have had good evaluations. Also, we have a place for more well-planned industry sabbatical leaves.

Make department real

People become real only if their environment is real. A department must assess realism of its program, people, and facilities. Allow me another word about Purdue. Our realism in undergraduate instruction comes naturally out of a total philosophy of departmental realism. It assumes preparation of our students to handle this environment. For example, we assume a high level of quantitative training [21, pp. 102–107]. But environment is necessary to make such background real. We do not emphasize differences among researchers, scholars, theorists, quantitative specialists, and adult educators; we call them all professors. Our joint appointments aid substantially. Our best undergraduate teachers can do good research, and in several instances they are our best adult teachers. They have been abroad. They can teach graduate students or supervise graduate theses. They do consulting. Our programs are departmental programs, not CES programs, international programs, AES programs, or teaching programs.

Realism is difficult enough with all working at a high professional level. It can rarely be established parochially for undergraduate instruction by special programs. Let me emphasize this point by saying that I feel my paper is as essentially relevant for adult educators as it is for undergraduate teachers. Fortunately, teaching technology of the future will mandate complementarity of teaching, research, and CES to spread the cost.

Bring professor and profession together

Two points are relevant. The first is articulated by John Sjo [34]. Undergraduate teachers apparently think they are being shunned by the Association. Frankly, if they are disenfranchised, I have a feeling it is self-inflicted. I agree with Boulding:

> There are no recognized tests by which economists can be distinguished from those who may claim, but who do not deserve the name. We have no professional qualifying examinations as do the lawyers, the doctors, the accountants, and in some places, I understand, the beauticians. . . . We do not even follow the practice of so many professions in improving their economic status by raising barriers to entrance. We may understand monopoly, but we certainly do not practice it. [7]

Undergraduate teachers were involved in the formation of this Association. They are an important group. If we have a problem, we should correct it. Neither the Association nor our professors should be out of touch with reality. Our students deserve a forum of respect for teachers. The profession must be a vehicle for defining and reinforcing reality.

The second point is more positive. It has to do with the "fourth revolution" in education as so well stated in The Carnegie Commission on Higher Education book, *The Fourth Revolution:*

> The first revolution occurred when societies began to differentiate adult roles, and the task of educating the young was shifted, in part, from parents to teachers, and from home to school.
>
> The second, in some places antedated by the first, 'was the adoption of written word as a tool of education.' Prior to that time, oral instruction prevailed, and it was only with reluctance that writing was permitted to coexist with the spoken word in the classroom.
>
> The third revolution came with the invention of printing and the subsequent wide availability of books.
>
> The fourth revolution, in Ashby's view, is portended by developments in electronics, notably hose involving the radio, television, tape recorder, and the computer. [3, p. 9]

My contention is that undergraduate teaching will get its greatest thrust for realism as this revolution occurs. The Commission concluded: "Higher education (and education generally) now faces the first technological revolution in five centuries in the potential impact of the new electronics" [3, p. 1]. They do not expect significant effect from this new technology on teachers until the 1990s (Fig. 3). I expect it sooner.

Teachers have a great future! Most research-oriented professors have had their batteries charged already. Some CES personnel have. Teachers are being asked to look at institutional changes going on outside education [9, p. 33]. They must also look at technology within the Land Grant troika, especially in research. Elementary teaching improvement is credited substantially to the science community [6, p. 107]. For the most part, the awakening to technological sophistication has not permeated teaching [1]. It must. Every undergraduate teacher should have read the Carnegie Commission Study by now.

The main social reform affecting education is accountability [25, p. 53]. It will keep pressure on. Fortunately, we have the technological hardware coming into proximity with our students and staff. We are getting needed quick turnaround. Our new teachers can put an arm around a computer. Technology and accountability are going to give us undergraduate teaching realism. Hopefully, such realism will not have to wait for a new generation of teachers.

Diversify approaches to realism

Realism is a quality ingredient of education, distilled out of professionalism and scholarship of the highest order. Any technique or program which helps an individual professor transmit realism or helps him teach a student how to recognize realism is to be considered. Departments must work out their own mix with thought and planning. Priority criteria are becoming available. Hopefully, this paper has put some of these in perspective. Much is happening and the place of specific techniques and ideas is impossible to predict. Lynn White said, "If one goes back sufficiently far in history, attempts at technology assessment, had they been undertaken, would undoubtedly have been consistently wrong" [16, p. 413]. But pervasiveness of tech-

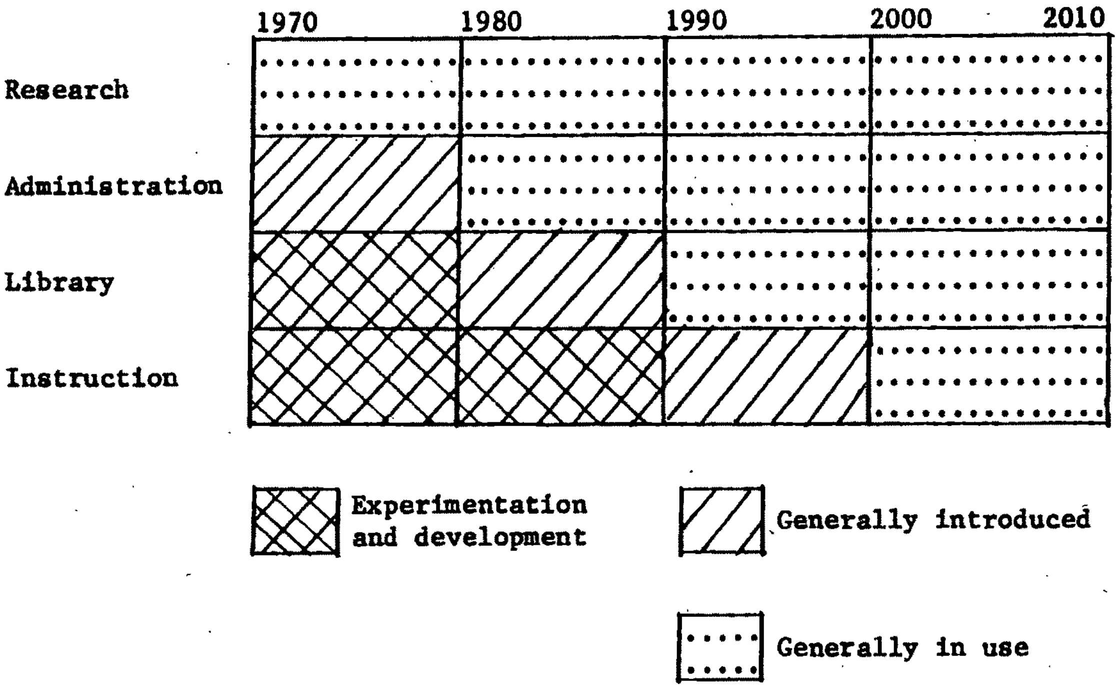

Figure 3. Estimated use of electronic technology (computers, "cable" television, videocassettes) in higher education

Source: Staff of the Carnegie Commission on Higher Education.

nology and its professional effects on science leave no doubt that a similar happening is ahead for education. The concepts of flexibility and innovation discussed by Carroll Hess are important [19, p. 5]. Diversified attacks will be needed. For example, the intern programs average about six students per year [36]. Designating a few students for such programs somewhat as a scouting party for professors and other students is obviously worthwhile. Frankly, I do not see wholesale movement in that direction. Programs that concentrate on bringing realism to the class make more sense to me. But these will do little unless we have professional professors.

Cherish the four years we have

Our responsibility for realism is massive, but it is not ours alone. For example, the Special Commission on the Social Sciences has urged "Officials in business and labor organizations to strengthen and broaden their existing association with the social sciences" [8, p. XVI].

Many of us vary on the purpose of education, but most of us know we have a huge job to get across the general ideas of: (1) developing the discipline of thinking (a former student, now a company president, told me the other day that the best thing we can do for the real world is to teach students self discipline); (2) conceptualizing with varying degrees of abstraction the situations within which analysis by thought or otherwise takes place; and (3) bringing to bear wisdom of the past, theoretical generalizations, analysis techniques, and means of creativity on problems of working and living.

Our capacity to contribute should be substantial. Exposure to "real worldism" of the university is a sacred privilege for a few. Tasting the uniqueness of the university is a once-in-a-lifetime experience. Four years is preciously short. We should selfishly cherish and defend our short exposure to our students. The rest of society has them for a lifetime. If we want to figure in that lifetime, we must, while we have them, teach them how to "learn to be." This unexpiring opportunity for learning is not to me a maintenance concept such as Schultz and others have claimed [33, pp. 3–31]. It is our opportunity to compound the accumulation of human capital by learning. Let us practice our special expertise in the art of learning with our students while we have them.

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Session 12

INTERFACING THE CLASSROOM AND THE WORLD OF WORK

Discussants: James G. Kendrick, University of Nebraska; Richard K. Noles, University of Georgia; Bernard L. Sanders, Farmland Industries, Inc., Kansas City, Missouri; Tom C. Veblen, Cargill, Inc., Minneapolis, Minnesota

Session 13

TRAINING IN INTERNATIONAL AGRICULTURAL DEVELOPMENT: THE ROLE OF THE AMERICAN AGRICULTURAL ECONOMICS PROFESSION

CHAIRMAN: ABRAHAM M. WEISBLAT, AGRICULTURAL DEVELOPMENT COUNCIL, NEW YORK

Objectives of International Training in Agricultural Economics

D. GALE JOHNSON

WHILE PERHAPS not intended to apply to American training in agricultural economics for foreign nationals, the following exchange brings out points that have troubled each of us:

> Q. "You have been sarcastic about what you call technocratic optimism. Does this mean that you don't put much store in the use of modern technology in the underdeveloped countries? Particularly, do you think the so-called green revolution cannot have a significant effect?"
>
> A. "I can tell you a story. I once visited a great university here with a glorious agricultural school located in one of the most glorious agricultural districts of America. There were a hundred Pakistani and Indian students present and they wanted to see me. When we met, I said: 'What are you doing here? There is nothing you can learn here that you can possibly apply back home among your mud houses in the villages.' And they appeared to agree with me. Conditions in the poor countries are vastly different from those here. Climate. Factor proportions. Social Relations. The technology they need is different from ours. Of course it should be modern, built on the latest scientific discoveries, but it has to fit their conditions."

The responder was Gunnar Myrdal [3, p. 31]. What answer can we give to the question: What can young men and women from developing countries learn through the study of agricultural economics in American universities that will help them when they return home? Is the answer, as given by Myrdal for a group of students studying some unspecified aspects of agriculture, nothing? Very little? Or a great deal?

As one who believes that science is universal—that the power to understand the mysteries of life may come from any place and any time and can have applicability to other places and times—I was amazed and shocked by Myrdal's advice to the students from Pakistan and India. Either Myrdal was being sarcastic when he described the institution that he visited "a great university . . . with a glorious agricultural school . . .," or he has little understanding of the relationship between research and technology. His response seemed to imply that all that was being learned from the American agricultural institution was technology and the technology being studied was appropriate only to the factor supplies of the United States or perhaps only of the agricultural region where the students were studying. The sciences of genetics, nutrition, pathology, physiology, chemistry, and hydrology have nothing to do with factor proportions or climate or social relations. Perhaps the students were studying only technology, but I doubt this very much. And it is clear that there is a great deal of American or European agricultural technology, with some modifications, that can be applied profitably in the developing countries. Some examples might be sprinkler irrigation, the control of the cotton boll weevil or the corn borer, the control of many animal diseases, or construction of irrigation dams.

But to speak critically of the position taken by Myrdal does not take us very far in understanding what American training in agricultural economics can contribute to the improvement of agriculture and welfare in the developing countries. It is my responsibility to discuss the objectives of international training in agricultural economics.

It is my view that the appropriate objectives of graduate education in agricultural economics for students who are nationals of the developing countries are the same as the objectives for high

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quality programs for Americans. We owe foreign nationals who are our students no less than we owe students from our own country. My colleagues on this program will undoubtedly suggest how we can improve the means by which we approach our ends or objectives.

The objectives of graduate education in agricultural economics are the development of:

1. a firm understanding of the major principles and theories of economics;
2. a grasp of the fundamentals of empirical analysis adequate to permit undertaking research on important economic problems involving the application of economic analysis;
3. an understanding of essentials of the analysis of public policies, including an appreciation of the strengths and limitations of economic analysis in such evaluations; and
4. the capacity to grow and develop one's capacity as a scholar, researcher, administrator and policy analyst.

Our objectives are not those of providing our graduates with answers to a series of specific questions but rather to provide them with the principles and tools that will permit them to answer the important questions that will arise in the years ahead. As our own experience indicates, the most pressing questions of today are likely to be replaced by a rather different set of questions tomorrow. If the function of our education was to provide answers to questions, rather than providing the capacity for answering questions, we would almost certainly be answering yesterday's questions and not even those of today, let alone tomorrow's.

These objectives, it will be said, are quite traditional or conservative and do not call for an extension or broadening of what most of us in the universities think we are now doing. This is a correct interpretation. I believe that the heritage of economic analysis and theory is a powerful and valuable heritage capable of growth and development in the future as in the past. I do not think that I am being parochial when I say that no other social science has the riches of theory, analysis, and approach to the understanding of human behavior that exists in the corpus of economics. This is said not to denigrate the other social sciences, but to indicate that we should be proud of what we have to offer.

It is true that economic analysis encompasses only a part of human behavior, though recent applications of economic analysis to a wider range of problems—marriage, crime, fertility, suicide—indicates that we have perhaps underestimated the generality of economic theory and the extent to which costs and benefits affect human behavior. But even as the more imaginative among us extend the range of behavior that economic analysis may illuminate to some degree, we should emphasize to our students that not all important decisions, whether of the farm, the family, the state, or the nation, rest solely or primarily upon the considerations that we are most capable of explicating. This is necessary for at least two reasons—it is true and it is perhaps of help in preventing undue or unnecessary frustration and despair when what is clearly good research or good advice is ignored, as it will be.

I said earlier that I felt that the objectives of graduate education in agricultural economics for foreign nationals should be the same as the objectives of high quality programs for Americans. There are, perhaps, two differences of some significance that we should recognize.

First, in the United States, Canada, and other industrial countries, the agricultural economist has a reasonably accurate perception of the various roles that he can perform in the various institutions of his economy. And these institutions have more or less accurate expectations of what it means to employ the services of agricultural economists. But the agricultural economists in most developing countries do not go home to equally well-defined situations. Some may well be the first agricultural economist with a Ph.D. degree to hold a position in a particular institutional setting in their country and perhaps the first agricultural economist with an M.A. or a Ph.D. We can, if asked, give our American or Canadian graduates a reasonably clear description of the expectations and opportunities surrounding positions in a large number of institutions, whether they be government bureaus, private firms, or universities. But I suspect that we often fail to realize how great the difference may be between the roles for which we educate our students and the actual roles envisaged by the various institutions that employ agricultural economists in many developing countries. As a directly related point, we need to recognize that in most developing countries an agricultural economist has far less support in terms of colleagues, libraries, equipment, and competent research personnel than we have. I am not sure that we can do much to prepare our graduate students for their far more difficult circumstances, except to recognize these conditions and to let our students know that such difficulties will confront them.

Second, a further difference is in the desirable breadth of the educational programs provided to Americans and foreign nationals. For students from our own country (and other industrial countries) we properly can emphasize a considerable degree of specialization. But because of the different circumstances facing the agricultural economist in the developing countries, some of which I have just enumerated, there is more need for general economic training or for more breadth in the education than we often provide for our own nationals. The agricultural economist in developing countries is more likely to be faced with problems of monetary and fiscal policy, international trade, import substitution, and exchange rates than is an American national employed in either a university or a governmental agency. Fortunately or not, the American agricultural economist can find acceptance of his role as a marketing specialist, a farm management specialist, or what have you and largely ignore matters lying outside a particular field. But in the developing countries agricultural economists are often, if not generally, expected to have the competence to deal with a wide range of economic issues. Obviously, if the length of the graduate program is to be approximately the same for both groups, some sacrifices must be made to achieve greater breadth for the foreign nationals. In the abstract it is not possible to say what should be given up in order to provide a broader understanding of economic phenomena, but I believe that those of us who are involved in educational programs for agricultural economists for the developing countries should consider what parts of our traditional requirements should be modified in order to broaden their backgrounds in economics.

I have so far emphasized the teaching of principles, theory, and tools as the major objectives of our training for students from developing countries. Whether or not properly classified as objectives, I would like to emphasize two additional ways in which we may be able to provide support and assistance for such students.

The first is a matter of historical perspective or perhaps, a comparative approach in which the comparisons occur through both time and space. The contrasts between the current productivity and income of the industrial and developing countries are obviously evident to any of our students who come to us from the developing countries. On the whole, Americans are oriented to the present and the future. It is quite possible by our emphasis upon current developments—the new and the emerging—that we give the impression, undoubtedly unintentionally, that our agriculture was always pretty much the same as it is today.

While there are major differences in any productivity measure that you choose for the developing and industrial countries as of today, one does not need to go back into history very far to discover that yields per hectare of cropped land or output per farm worker in the industrial countries were similar to the current measures in the developing countries. While the yield of all grains per hectare in the United States is now three times the yield in India, the U. S. grain yield in the 1920s was only 20 percent above the average for India in 1969–71. In fact, if the world is divided into two parts—industrial and developing—the average grain yields were the same during 1935–39 while there is now a difference of 50 percent.

As we all know, Japan has emerged as one of the major industrial countries of the world and has now reached the European level of per capita GNP. Yet, according to the calculations made by Hayami and Ruttan, the agricultural output per male worker in Japan as of 1910 was approximately double the figure for India in 1965 and below that of Mexico, Columbia, Peru, and Brazil as of 1965 and approximately the same as in Ceylon, the Philippines, and the United Arab Republic [2, p. 73, App. B].

The output per male worker in France as of 1880 was below the 1965 estimate for Brazil, Columbia, Taiwan, and Venezuela and the same as for Turkey. The French did not reach the 1880 U. S. level of output per male worker until the 1930s [2, p. 73, App. B].

There are other aspects of the historical perspective that it would be well to recognize, such as life expectancy. At what date was life expectancy in the United States and Western Europe the same as now prevails in India and developing countries generally, except in Africa? I will leave it to you to find out.

There are a number of opportunities for including information relevant to time and place comparisons. Speaking personally, I have done so in a course on agriculture and economic growth as a part of the discussion of the contributions that agriculture can and has made to economic growth and of consequences of economic growth to agricultural employment, share of national income and the growth of yields (man and land) on farms. I would think that similar material could be included in a course in agricultural policy that had something of a comparative approach or emphasized historical developments of agriculture. It could be included in the somewhat rare course in agricultural history, again if such a course involved a comparative approach or covered more than the United States. Since I believe that time and place comparisons also add to the perspectives of American students, I think an effort to provide such comparisons would be of value to all the students involved.

The second way in which we can provide support and assistance to our students from the developing countries is to try to understand and to have them, in turn, understand why there are such large differences in productivity and income between the developing and industrial countries at the present time. If Hayami and Ruttan are anywhere near the mark in their *Agricultural Development: An International Perspective* [2], differences in natural resource endowments relative to the number of workers do not explain most of the wide disparities in output per worker. Output—and income—differences are due much more to differences in modern inputs, the amount of research or highly trained manpower, and in human capital per worker. While no road to development is an easy road to travel, the roads that depend on resources that can be augmented are almost certainly easier ones than if there were a limiting resource that could not be augmented at all or by relatively little.

The results by Hayami and Ruttan are clearly consistent with T. W. Schultz's analysis of the declining relative importance of land rent [4, p. 47]. Their results are also strongly fortified by the important studies by Evenson and Kislev contained in *Agricultural Research and Productivity* [1]. This work, which hopefully will be published in full this year, investigates the productivity of research in the developing countries. Among their most striking results is that the internal rate of return on investment in agricultural research is greater in the developing countries than in the developed. In part, this result is due to the functional form of the equation and the lower levels of investment in research in the developing countries. As estimated by Evenson and Kislev, only 11 percent of the world's publicly supported agricultural research was undertaken in the developing countries in 1965 [1, Ch. 2].[1] A further major finding was that a developing country can effectively borrow from other countries only as it has a significant indigenous research effort.

We should not, of course, create an unrealizable degree of optimism about the rate at which the developing countries might approach the current or recent levels of income and productivity of the industrial countries. I must admit to the nagging feeling that there is very little prospect that countries with very large populations, such as India or China, can achieve income growth rates equal to those of Western Europe or North America in the late 19th century or the early 20th century. Yet is large population a relevant variable? Or is it population density? Or does even population density make any difference? Japan and Taiwan have population densities of the same general order as India, not to mention the Netherlands. These few musings indicate, I fear, that we do not have an adequate theory of economic development.

An important goal that we should have is to eliminate the need for substantial numbers of students to leave their home countries or regions and come to the United States or other industrial countries for advanced education. How fully we meet this objective will be an indication of how well we meet our other objectives.

While we can have little control over whether the developing countries will create sufficient numbers of high quality educational institutions that can provide the desired graduate education opportunities, we can contribute to that objective by providing those who now come to us for graduate education with both the skills and the motivation to develop high quality programs within their own institutions.

I do not believe that it is utopian to predict that most of the larger developing countries can have, within two decades, university-level educational and research programs in agricultural economics of high quality and with the capacity to provide most of the required higher education. By larger developing countries I mean those with populations of 10 million or more. Most of those smaller than this will either have to forego such development or cooperate with other developing countries. Obviously it would be possible for the very small countries to develop good programs in agricultural economics if they neglected other areas of the agricultural sciences or the sciences generally. It is not at all obvious that such would be to their advantage. In effect, I believe that what is required is the achievement of a substantial level of activity of high quality in several disciplines.

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[1] Agricultural economics research is one component of agricultural research. Separate data by fields were not given.

One factor that may inhibit the development of high quality graduate education programs in the developing countries are two aspects of the employment of agricultural economists. In the United States we had almost a quarter of a century—say from 1910 to 1933—to develop departments of agricultural economics before government became a major competitor for the services of agricultural economics. And most of the agricultural economists who did go into governmental employment during that period were engaged in research. The rather sharp change in the role of government in agricultural affairs after 1933 which provided employment for a substantial number of agricultural economists in policy and administrative roles came at a time when there was a substantial pool on which to draw. In fact, I suppose that we have to say that under the employment conditions prevailing in the thirties that if the government had not provided employment for a considerable number of agricultural economists, many completing their education at that time would not have had careers in agricultural economics.

In the developing countries today it is not at all certain that a highly qualified agricultural economist will be a university faculty member. Government employment, which as yet in most developing countries provides little research opportunity, may be much more attractive than a university position. In addition, employment by private firms or the socialized production sector is almost certainly relatively more important for agricultural economists in the developing countries today than it was in the United States in 1930.

While I have not undertaken any surveys, it is my impression that a significant fraction of the ablest of the agricultural economists do not seek employment as agricultural economists but seek positions as general economists or in some specialty other than agricultural economics. In most of the developing countries the agricultural colleges and universities are not the prestige academic institutions. The development of our land grant universities, several of which have emerged as among the great universities of the nation and the world, has given a rather higher prestige rating to agricultural economics in the United States than has perhaps prevailed anywhere else in the world and certainly much higher than in the developing countries. And even in the United States it can hardly be said that the prestige rating of agricultural economists is at or near the top for economists generally. But if occupational prestige is an important aspect in the choice of the type of an economist one is going to be, agricultural economics in the developing countries lose some of the ablest who would be qualified as agricultural economists.

If you have stayed with me this far, you may well ask why I have been talking about the objectives for the education for agricultural economists rather than for economists. Much of what I have said is equally relevant for economists generally, but not quite all. To a degree, and I mean this in the best sense of the word, agricultural economists are advocates. Our uniqueness depends upon our special knowledge of farming and farm people and our concern for their welfare. This is not to say that we have or should work for special privileges and benefits for farm people, but I feel that agricultural economists can quite properly emphasize the need for a relatively even handed treatment of farm people relative to urban people. In all of the industrial countries that I know anything about, there has been a systematic neglect in the provision of social and cultural services available in rural areas and a significant discrimination against farm people in the investment in human capital through formal education. Many of the urban and rural differences in the industrial countries have by now been substantially eliminated or greatly reduced, but only after the farm population is no longer a significant share of the total population. But I see no evidence that the policies of the developing countries are in any way less neglectful of farm people than were the policies of the industrial countries in past decades. Thus I believe that we can be quite proud if we attract to our universities young men and women who are interested in and concerned about the welfare of farm people and if we are successful in providing them with the knowledge and insights that may help them to prevent the developing countries from making the same mistakes the industrial countries have made.

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Institutional Roles and Training Issues in International Agricultural Development*

Darrell F. Fienup

This paper examines the changing roles and the relative strengths and limitations of foreign and domestic institutions in terms of formal degree and non-degree training and related research needs in the economics of agricultural development in the LDCs. The U. S. agricultural economics profession has been heavily involved in formal degree training of LDC students. Our primary concern is how changing capabilities, financial support, and aspirations in U. S. and LDC institutions are affecting the role of the U. S. profession in international agricultural development. A related question concerns ways and means by which U. S. universities can strengthen graduate training for LDC students and make it more useful in meeting their needs.

Our second major concern deals with the roles and relationships between U. S. and LDC universities on one hand and international research and training centers on the other in both degree and non-degree training. Is there a proper role or comparative advantage for each major type of institution, and, more important, where can increased linkages and complementarities be developed? The newly developed International Agricultural Research Institutes are of particular interest.

A central proposition is that non-degree training has been most neglected by U.S. universities, yet may offer the greatest potential for improving the effectiveness of formal degree training. Education in any discipline, or set of related disciplines, must be viewed as a continuum in which training needs do not begin or end with the attainment of an academic degree. Many U. S. universities offering M.S. and Ph.D. training to LDC students have either lost sight of this fact or for a variety of reasons have been unable to maintain professional contact and establish collaborative relationships with LDC graduates to meet their continuing needs for professional growth. It is further postulated that this deficiency has limited the competence and effectiveness of U. S. professionals and institutions in their international agricultural development activities. A whole range of non-degree training and research needs lie outside degree training. By and large these activities have been limited, and mostly carried on in an ad hoc and uncoordinated fashion. What are the opportunities and limitations for increased U. S. university involvement?

It would be presumptuous to represent this effort as a synthesis of the 12 background papers and the many contributions of the more than 50 professional agricultural economists who participated in three AAEA workshops held earlier this year on the role of the U. S. profession in international agricultural development training. At the same time, this paper draws heavily on the ideas and analyses presented and attempts to reflect at least some of the prevailing issues and viewpoints. It seems evident that at least part of the U. S. profession has a substantial commitment to international agricultural development. The problems are pressing, and expanded efforts are needed to strengthen international training and research.

Changing Role of U. S. Universities

As Owen [8] has indicated, the ultimate rationale of training LDC students in developed country (DC) institutions, including the U. S. and other developed countries, is recognition of "the concentration of these institutions of higher learning and research in the DCs and the need to move toward a more equal distribution of this critical resource in the interest of a higher rate of sustained development in the LDCs and greater generalized equity throughout the world." The DCs need to reinforce the limited capacity of the LDCs to train the professionals needed as an essential means toward that end. Significant attention should be given to LDC institution building, especially the universities, in order to move more rapidly toward a correction of this imbalance.

A further justification for DC institutional involvement comes from recognition that "the more

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important problems facing most countries (inadequate food supplies, underemployment, technological stagnation, external insecurity) cannot be understood and resolved in a framework of national isolation. International communications and cooperative research are essential ingredients for a more effective attack on these problems—which can only be strengthened in the long run through an expanded interchange of students and scholars. This implies a need to move farther toward more cooperative arrangements, especially among universities which provide the most logical bridge among nations in matters of education" [8].

A great deal has been accomplished since World War II in building capacities in U. S. universities for training and research in international development. Substantial expertise has been developed through participation in technical assistance programs sponsored by various development agencies and in working with and advising the large numbers of foreign students that have been and continue to be trained in U. S. universities. A 1974 ADC survey of 55 responding departments shows 1480 LDC students entering graduate programs (29 percent of the total) in the economics of agriculture over the past five years and annual enrollment has been increasing [12]. In addition to the community of scholars with experience and interest in international agricultural development, many U. S. universities have also developed a substantial infrastructure in library, language training facilities, and other services in the international area. Most have the range and depth of disciplines necessary to meet a diversity of training needs, including the agricultural and related social sciences. Opportunities exist for a more integrated and interdisciplinary approach to training and research in agricultural development.

At the same time that professionals are anxious to participate, and related infrastructure is largely in place within U. S. universities, a prevailing concern of participants in the earlier series of seminars was that opportunities for involvement and specialization in international agricultural development are diminishing. This feeling was most strongly voiced by staff of universities that have concentrated on M.S. programs. State legislatures and university administrators are often not deeply committed to international activities and respond largely to changing political moods. Staff with commitment to international development have not vigorously promoted their interests through campus activities or better education of the public. Lack of ongoing financial support for staff positions, research, and training activities—particularly on campus—for international activities is a key limiting factor. A related consideration is a growing nationalism in the developing world and a desire for self-determination which has reduced the effective demand for U. S. professionals overseas.

Issues in U. S. Formal Degree Training

The continuing high demand for U. S. degree training by LDC students in the economics of agricultural development provides an important indication of the value of U. S. degree programs. Many argue that objectives in training for foreign students are and should be the same as those for domestic students, i.e., to develop good economists with adequate preparation in theory and analytical methods. It is argued that if the graduate is properly prepared, he should be able to apply the general tools of economics to the problems of his own environment. In most U. S. universities foreign students do in fact follow essentially the same programs and are required to meet the same standards as a U. S. student. But the nagging question remains that LDC students often face difficulties in applying these tools when they return to their own countries.

Agricultural economics developed as an applied science based on the concept that knowledge should be useful and directed toward the solution of real problems. Some members of the U. S. profession are concerned about overspecialization and excessive "discipline orientation." The charge is sometimes made that economists and agricultural economists increasingly are only "talking to each other" and within smaller and smaller groups. Reading prelims with questions dealing with the application of theory and quantitative methods to real world problems has caused some to question what has happened to our problem-solving orientation? Many newly trained Ph.D.'s from LDCs return to their countries poorly equipped to work independently and deal with pressing problems of development. Domestic graduates employed in U. S. institutions at least have the opportunity to continue learning on the job through interaction with peers and more senior colleagues.

The rigidity of our own institutional structures, partly related to discipline orientation but also to the established formalities of academia, work against innovation and change. It is difficult to arrange for a qualified professional to formally advise graduate students if he is not a staff member of that university. It would, for example, be extremely helpful if a qualified professional resident in an LDC could advise a graduate student working on his thesis in that country even if he was not a member of the student's U. S. university faculty. How many U. S. departments and universities would be willing to accept foreign students and work with them for six months to a year as part of their degree programs in a foreign university? Admissions and foreign language requirements represent other areas of rigidity. However, one of the greatest deficiencies surrounds interdisciplinary training. Established academic standards for a trained economist allow little time to take courses outside of economics, mathematics, and statistics.

Other problem areas or limitations in U. S. graduate training for foreign students elaborated by Falcon and Pearson [2] as well as other seminar participants, include student selection, high cost of U. S. graduate training, thesis problem selection and guidance, and post-doctoral assistance and follow-up. Although knowledge about foreign institutions and the programs they offer is increasing, it is still difficult to evaluate transcripts and letters of recommendation to admit foreign students. High costs of graduate study also result in selection often being based more on a student's having adequate funding through his graduate program than on his intellectual capacity. Increasingly more attention is being given to the LDC student's thesis research, recognizing that in-country thesis development can be an important part of the student's academic training. However, this raises problems of funding, adequate guidance, and selection of topics useful to the country and the student's training.

Nearly all earlier seminar participants endorsed the need for more follow-up and post-doctoral assistance to LDC graduates. "There is the difficult problem of keeping the newly minted Ph.D. professionally and intellectually alive after he or she has returned home." "The idea that the new Ph.D. can conduct independent research is largely a myth." My own experience of working nearly 10 years to help establish an agricultural economics profession in Argentina indicates that it is not enough just to train nationals through the Ph.D. and expect the profession to move ahead on a self-sustaining basis. Follow-up activities of many kinds are critical over a sustained period if the desired objectives are to be achieved. More professional interchange including joint research, post-graduate fellowships, travel grants for workshops and seminars, and circulation of publications are some of the methods which can be used to overcome these deficiencies. This is a positive approach to overcoming training limitations at the doctoral level as only marginal changes in the structure and content of U. S. based Ph.D. programs are likely.

Professional Development in LDC Universities

The very definition of development requires the LDCs develop their own universities and scientific institutions, and establish indigenous disciplines and professions to meet national training, service, and research needs. This implies being able to reproduce their own scientific talent in their own institutions. In the initial stage of development of any profession, all nationals must be sent abroad to be trained. Once these individuals return, indigenous teaching and research programs can be initiated if a critical mass has been formed and the necessary support provided.

Often a new profession such as agricultural economics must first demonstrate its usefulness and generate a demand for its services before a country is willing to fully support it from scarce national resources. A key ingredient to the success of such efforts is a dedicated and well trained national cluster of full-time professionals who take responsibility for directing and enlisting local support for their programs. The U. S. profession has had considerable experience in helping establish Masters programs in agricultural economics, especially in Latin America and in parts of Asia and Africa.

The major objective of profession and institution building in the LDCs is to help them develop their own human resources at different levels in terms of national needs and priorities. This is a development process that must proceed in stages. As Masters programs become stronger and increase their capacity to train ever larger numbers of nationals, fewer will need to go outside for this level of training. Major emphasis must be given to generating a body of national research through Masters theses on relevant country problems during this stage of professional development. Not only is this required to meet national needs and to adequately train agricultural economists, but it will form the necessary base on which to build doctoral programs. The step from M.S. to the Ph.D. is a major one and implies the necessary formation of associated disciplines and institutional infrastructure.

As part of the three AAEA-sponsored workshops, several background papers were prepared on the stage of development of agricultural economics in Asia, Africa, and Latin America [3, 6, 7, 9]. General conclusions were that both Asia and Latin America generally have or are rapidly approaching the capacity to train most of their own professionals through the Masters level, but only a few institutions in the LDC world can offer what approaches a U. S. Ph.D. degree. Progress in overall professional development has been remarkable given the short time most programs have been operating. Africa's stage of development is considerably behind both Asia and Latin America, with Nigeria as the only African country with any real strength in agricultural economics. The University of Ibadan is the strongest of only two established M.S. programs on the continent and has six students currently enrolled.

These developments have significant implications for the future training role of the U. S. agricultural economics profession in international agricultural development. The general concensus in the earlier workshops was that U. S. universities would increasingly concentrate on offering Ph.D. training to LDC students, which will likely be further consolidated in fewer institutions. Obviously for much of Africa and in many of the poorer nations of Asia and Latin America, a strong demand will continue for M.S. training. In the latter cases, students from poorer countries without Masters programs are being encouraged by some funding agencies to study in the region, but this capacity does not yet adequately exist in Africa.

At the same time that these developments should be encouraged in the interest of building sustained professional agricultural economics competence in the LDCs, some arguments were presented for continuing M.S. training in the U. S. Most U. S. Masters programs are flexible and give students access to some good courses and exposure to our system. They do not overwhelm the LDC student like many Ph.D. programs, and they provide an opportunity for observation and screening on both sides [5]. The proposition was also advanced that in terms of many tasks to be performed in LDCs, the benefits to be expected do not increase with the duration and specialization of the foreign training experience as the costs do. Also, many U. S. universities have excess capacity at the M.S. level and are not that expensive in terms of opportunity costs [8].

Available information on U. S. enrollments shows a strong continuing demand for M.S. training. This may be explained in part by the accelerating demand for agricultural economists in most LDCs, the continuing strong preference for a U. S. degree as many foreign programs are still establishing their credentials, and at least through 1973 the decisions of some funding agencies (particularly USAID) to support large numbers in the U. S. for M.S. training [10]. However, the trend toward increasing capacity of indigenous Masters training and related research programs in the LDCs is clear and should receive strong encouragement from the U. S. profession.

Indigenous academic training and research programs are able to meet many of the deficiencies noted in our own. They eliminate the language problem and are essentially forced to be more relevant to national problems and needs. More teaching examples must be drawn from local situations, economic theory must be more selectively used, and research efforts tend to be more meaningful. Primary data needed for research can be gathered at minimum cost. In fact, the entire cost of training is substantially reduced in relation to sending students to the United States.

At the same time the establishment and maintaining of a new graduate program is not easy. It is highly demanding and requires great dedication of the nationals involved. Institutional rigidities and often opposition from the older "professional establishment" requires major energy and time be given to political, organizational, and administrative matters. Staff members are few and expected to be experts in everything. Many are forced to add other jobs to supplement their low salaries or as a hedge against institutional instability, and often both. Programs are usually poorly financed and the infrastructure of supporting services (library, secretaries, calculators, expenditures, and space) limited. The job is difficult but it is being done.

Role and Linkages of International Development Centers

Institutions in this category represent a relatively new institutional form established to meet pressing societal needs not being met by existing institutions, or to meet them better and sooner. As such they are highly problem-oriented with clearly defined objectives. The newest of these institutional structures are the International Agricultural Research Institutes which have focused attention principally on increasing production of food commodities vital to the subsistence of large masses of the poor in the LDCs. Some also restrict their efforts to the problems of producing the crops for which they have responsibility in defined geographic and climatic regions.[1] These institutes were created to accelerate the development of new technology for specific crops and to speed its adoption in the poor countries.

The Agricultural Development Council (ADC) falls in this class of institutions, having their main focus on rural development in Asia. They have supported the U. S. graduate training of large numbers of Asians, principally in agricultural economics but also in related social sciences. The Council has selected and worked with this cadre of trained Asian rural social scientists in teaching and research programs in Asian institutions over the last 20 years. Resources for the Future (RFF) has its focus on research in natural resource use and development, centered mainly in the United States. They have, however, a Latin American interest as well and are currently working to form a network of Latin and U. S. scholars concerned with the economics of water utilization. All the foregoing institutions are private, outside the academic framework of a university, and are funded by international development agencies and foundations.

Our concern is with the strength or capacity of these institutions to meet training and research needs for international agricultural development. Also, what is their role in the mix of institutions concerned with development? First, their mission is usually well defined, and they have sufficient flexibility within their scope of operations to move rapidly toward problem-solution. Interdisciplinary research and training are easier to facilitate within this framework and in fact are usually required to meet their objectives. There is less bureaucracy, decision making is simpler, and new knowledge can presumably be disseminated rapidly to potential users. They are generally well equipped to provide non-degree training within their areas of competence. All these may be viewed as advantages, *vis-à-vis* universities in terms of their ability to focus on finding solutions to relatively specific problems in less time and to disseminate that knowledge rapidly.

Obviously all problems do not come in this dimension. Among the international institutes, the International Rice Research Institute probably has the most narrowly defined focus—to increase productivity and production of rice in South and Southeast Asia. But this is not a simple problem—as rice is so basic that it cuts across nearly all aspects of life of the people and countries of this region of the world. This implies a need to establish linkages with scholars and institutions both in the regions served and in the developed world. Most of the centers in fact are doing this both for academic and non-academic training and research.

The international institutes are strongly oriented to the biological sciences with a small agricultural economics and rural social science component. The staffs of most of the institutes are envisioned eventually to have two to three Ph.D. agricultural economists and perhaps one sociologist or anthropologist.[2] Economists work closely with biological scientists, a phenomenon not extensively found in the land grant universities. Training objectives for non-economists are to emphasize basic principles of farm decision making and the basic elements affecting the supply and demand for agricultural commodities. For economists, supervising thesis research in connection with an LDC academic institution has been a main focus of training activities. At IRRI, as in most other centers, a relationship has usually been established with an adjacent national institution.

In the economics programs many other non-academic training and research activities that involve outreach and networks in the regions served have been and are carried on. These include workshops, conferences, and joint research projects with scholars and institutions mostly in the developing countries. Limited opportunities also exist for thesis guidance of Ph.D. students from U. S. universities. Given the limited professional economics staff of the institutes, these contacts and interactions are necessary to accomplish overall objectives as well as multiply the effects of their work. They can perform an important integrating function.

The ADC may be viewed as a highly successful model for contributing to international agricultural development objectives. Strong emphasis has been given to formal academic training of Asians to staff Asian universities [11]. Since 1954 some 2?6 have been trained for M.S. and Ph.D. degrees. But the most significant aspect of the ADC program has been the major attention given to follow-up, interaction, continued support, and encouragement to these scholars over an extended period in their home institutions. The ADC maintains a cadre of professional associates in the field to work with the newly trained professionals and their peers in indigenous teaching and research programs. A critical mass of Asian scholars with common interests and training form the basis for continued interaction and growth. ADC organizes conferences and workshops, encourages joint research, supports visiting professorships among Asian universities, and provides opportunities for post-doctoral study. These non-academic postgraduate training activities are some of the most critical needs for LDC professional development.

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[1] There are six operating institutes including IRRI, CIMMYT, CIAT, IITA, ICRISAT, and CIP, and others are being formed.

[2] See Barker [1]; much of the following discussion of IRRI draws on his paper.

Both ADC and the International Centers are working to develop professional competence and strengthen research and academic institutions in the LDCs. Substantial attention is given to non-degree training activities and the formation of research networks. There is a strong dependence on U. S. and other DC universities to provide formal degree training for LDC professionals with whom these institutions carry on their activities, but U. S. universities and professionals have had only limited involvement in collaborative research and network activities. Without continuing relationships and research experience in LDC countries, the strength and relevance of U. S. formal degree training can be expected to decline. The U. S. profession needs to play a larger role in non-degree training and LDC network activities.

Need for Non-degree Training

This area appears most neglected, yet may have the greatest potential for improving the effectiveness of the American agricultural economics profession in its international agricultural development efforts. In his background paper, Price Gittinger [4] has defined non-degree training to include everything that is not part of a formal academic degree program. Some of the LDC needs for this type of training and the methods used have been mentioned previously, but not systematically elaborated. Gittinger enumerated several basic needs including lack of opportunities for the newly trained LDC professionals to continue learning on the job, limited access to training in and application of recently developed techniques lacking in their academic training or not suitably intensive, and a general and pervasive need to keep in touch and involved with their colleagues throughout the region and in other regions of the world. The methods used to help correct these needs include in-service training, short courses, and both formal and informal networks. Networks involve activities such as workshops, seminars, joint research, and exchange of publications.

It is remarkable that so little emphasis has been given to non-degree training. Relatively few concentrated efforts can be identified, and support has come from a very small group of sponsors. Gittinger estimated that four-fifths of the support for these activities has come from USAID as the major but declining source, and from two private agencies on a regional basis including ADC in Asia and the Ford Foundation in Latin America. Part of the explanation is that up to now most U. S. departments of agricultural economics have given little attention to this area of activity. Once the LDC student leaves the campus with his shiny degree, contact usually ends. This deficiency requires serious examination not only for the sake of the developing profession abroad but for the U. S. scholar as well.

Short courses

A comprehensive listing and analysis of non-academic training efforts is not attempted here, but a few major examples are presented. USAID has been the major organizer and supporter of short courses on a systematic basis. Fifteen courses are listed and 771 have participated from 1969–73. They cover a wide range of topics on the economics of agricultural development. A majority are offered by federal agencies and some by universities under USAID contract. The World Bank (IBRD) through its own Economic Development Institute is probably the second major supporter offering project analysis short courses in Washington, D. C., and rural development project courses overseas. Short courses are also offered by the IDB, OAS, and FAO, but they are more limited in number. There are a few university examples including the Economics Institute at the University of Colorado and the management skills short course at the East-West Center (Honolulu). Michigan State University has a one-year intensive program to provide training in simulation models of the agricultural sector and a parallel program for computer programs. There undoubtedly are other examples, but generally short course offerings are minimal.

In-service training

In-service training has been offered principally by USAID; 322 persons have participated over the past five years. This is an activity not easy to arrange as individual needs must be fitted into on-going programs. Probably the greatest success (but not emphasizing agricultural economics) is the in-service training offered by the International Agricultural Research Centers. Agricultural production scientists from the developing countries are brought together and work through the season with a particular crop from planting through harvest. Experimental design, planting, fertilization, pest control, plant breeding and selection, other cultural practices, and quality evaluation are emphasized. There is exposure to many disciplines but the focus is on increased yields. This approach may be instructive in terms of design and focus of in-service training for agricultural economists. Up to now, it has not received much emphasis, but warrants further exploration.

Emergence of research and training networks

By far the most interesting and growing development in non-degree training is that of providing better linkages and interchange through formal and informal networks. The U. S. Research and Training Network (ADC-RTN) is a new institutional form designed principally to strengthen the professional capacities of U. S. agricultural economists in international agricultural development. The principal device used to implement this objective has been through the support of seminars and workshops focused on critical training and research areas. Originally the program was supported by the Ford Foundation and the last four years by USAID. It is currently being evaluated in light of changing situations and needs in both the U. S. and LDCs. One of the directions is toward much greater involvement of foreign colleagues.

An Asian network has been initiated largely through ADC efforts and is considered one of the most successful. Relationships between former Council members and ADC staff have been built over a long period. Currently they are operating with a grant from the Canadian International Development Research Council (IRDC) to expand and strengthen the Asian network. Major emphasis has been on conferences and workshops, but many other activities have been supported, contributing to the networks concept. Another network effort has been initiated in Africa through a set of related cross-country research projects on rural employment. Michigan State University is providing the leadership with support from USAID. CIAT in Latin America is organizing a network on the economic aspects of livestock production. Resources for the Future is working to establish a water utilization network involving U. S. and Latin economists.

The significance of network efforts are that they provide a two-way street among professionals with common interests. A framework is provided to overcome isolation, increase competence, identify important training and research problems, initiate joint research activities, and facilitate exchange of professors and students as well as training and research materials. They may be organized by a variety of institutions and professionals but need support for at least 10 years to become viable. The ADC-RTN in the U. S. may be the most important vehicle to facilitate U. S. linkages with LDC networks. Obviously networks must meet real needs and require commitment on the part of participants to succeed. Networks are not the answer to all problems of training and research in international development, but they significantly complement academic training and offer one of the most promising opportunities for the U. S. profession to increase its involvement in international activities.

Summary and Conclusions

During the 1960s U. S. universities built substantial competence in the economics of international agricultural development. This was encouraged by strong on-campus support for staff positions and activities in international development, many opportunities for overseas assignments in technical assistance roles, and large numbers of foreign students enrolled in Masters and Ph.D. programs. During the 1970s this situation was largely reversed as the U. S. became more isolationist and support for university based international work substantially declined. U. S. professionals also have fewer opportunities for overseas contacts and experience. However, the numbers of LDC students who seek advanced training in U. S. universities continues at a high level. This has left the academic community with a sense of frustration as to how to maintain their competencies in development and continue to serve the needs of LDC students. Training and research needs dealing with the problems of world food supplies and the rural poor in the developing countries are increasing while U. S. capacities to deal with them are declining.

The developing countries have made substantial progress over the past 10–15 years in building their own institutions and cadres of professionals. In much of Asia and Latin America, and to considerably less degree in Africa, capabilities exist for training professional agricultural economists to the Masters level. Many of the graduate programs in LDCs were initiated with U. S. technical assistance, but are still finding their way to become truly national and self-sustaining. LDC professionals are generally young, lack experience, and are still few in number. Most programs still need outside support. What is significant is that there is a nucleus of trained professionals in most LDCs with which U. S. and other developed country scientists can interact. There is also a growing sense of independence and need in the LDCs to develop their own solutions to their own development problems.

It is recognized that large numbers of foreign scholars have received their training in U.S. institutions and this will continue for many years, especially for Ph.D. degrees. There is not only the continuing need to provide relevant degree training to LDC students in U. S. institutions, but also to make possible an ongoing scholarly interaction as they establish their own indigenous research and graduate programs. The U. S. profession has a substantial role to play in this process—but the nature of association must change from the past student-professor relationship to one of professionals interacting as equals at a pace and in ways the LDCs will allow.

Formal degree training of LDC students can be improved in U. S. universities. General consensus does not exist on how this should be done. In part this may be attributed to the multiplicity of roles to which LDC students return. It is also an indication that all LDC training needs cannot be met through a U. S. Masters or Ph.D. degree. At the Ph.D. level, most would agree that the basic core of theory and quantitative methods should remain. However, more can be done to provide experience in the application of theory and method in formal course work. There are some basic issues about the type and emphasis of theory taught. U. S. economics deals largely with equilibrium situations while most LDCs are in disequilibrium and there are problems in theoretical transition. LDC students also leave our universities poorly prepared in Marxian economics, yet must face these issues at home.

There is a need for more flexibility in U. S. universities to accommodate new institutional forms for graduate training. As foreign institutions initiate doctoral programs, it may be necessary for a student to take part of his course work in the U. S. for credit in his LDC university. Reverse arrangements are also needed. A qualified professional, resident in an LDC, should be able to guide the in-country thesis research of a student working toward a degree for a U. S. university. More exchange professorships between U. S. and foreign institutions would enhance the quality and relevance of graduate programs in both institutions. Cooperative arrangements are difficult to implement but offer benefits to all who participate.

More emphasis should be given to Ph.D. thesis research. Many LDC students never complete their theses, yet the experience is invaluable for their future professional activities. Most feel that LDC students should have the opportunity to conduct thesis research in their own countries, especially if adequate guidance and financial support can be arranged. This gives the student valuable research experience on a relevant problem in his own country, helps build an indigenous research base, and also keeps the U. S. major professor involved and knowledgeable in LDC problems. Outside funding is often critical to insure that the returning student has the time and support needed to carry out his research.

International funding agencies have given increased attention in recent years to supporting development efforts directly in the LDCs. This has taken the form of grants and loans to national efforts in establishing indigenous graduate programs, problem focused research activities, and the formation of LDC networks. Another significant development has been the formation of the International Agricultural Research Institutes located in the developing regions. Their success depends on rapid generation of new technology on basic food crops with wide adaptability that has the potential to increase yields substantially above current levels. A further and more critical criteria is that potentials in the form of increased food production must be realized in the LDCs. Basic research beyond the capacity of the institutes may be required to achieve the yield breakthroughs desired. LDC biological and social scientists must be trained through M.S. and Ph.D. levels to develop indigenous capacities to conduct adaptive research on new technologies and to design and implement policies for their adoption. This suggests the need for stronger collaboration with U. S. and other developed country institutions to carry on basic research and degree training functions. Up to now, coordinated support for these activities has been limited.

Non-degree training and research activities offer substantial opportunities for increased involvement of the U. S. profession in international agricultural development. Attention has been given to formal degree training at the expense of post-doctoral follow-up and in establishing ongoing professional collaboration with LDC graduates of U. S. institutions. Training must be viewed as a continuing process, and LDC graduates have special needs especially during the first 10 years of their professional careers. Working conditions in LDCs make this especially critical in comparison with graduates employed in developed countries who continue learning on the job.

Much can be gained through formation of formal and informal networks of scholars between the developed and developing countries. Joint workshops and seminars, collaborative research efforts, professor and student exchange, and circulation of publications can be used to strengthen international activities in U. S. resources base universities and developing country institutions. The International Institutes should form an important part of these networks when problems in their areas of concern are involved. U. S. universities should also explore the possibility of expanding their role in short courses and in-service training at both pre- and post-graduate levels.

Finally, it is strongly emphasized that the U. S. professional community needs increased financial support to develop these activities. Both public and private funding agencies have less resources available, and the current political climate for increased funding is not favorable. Yet the U. S. agricultural economics profession has a strong obligation to make the case for increased support. It is vital to the future of the developing world and to the longer run well-being and interest of the United States.

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Ways to Improve International Training

LYLE P. SCHERTZ AND WALTER P. FALCON

A REVIEW of training related to the economics of agriculture for lower income countries (LIC) was sponsored during the past year by the American Agricultural Economics Association.[1] The study, which was conducted by the International Committee, focused largely on improvements that could be implemented within American institutions. The review involved widespread participation and made committee members much more sensitive to the training needs of foreign students [7]. It also provided a better understanding of the merits of various institutions engaged in this type of training [4] and produced many suggestions for improving the educational training process. Our purpose in this paper is to identify those recommendations which might be embraced and supported by a substantial majority of the Association membership.[2]

Recommendations of Seminar Participants

The review meetings identified "Anticipated Characteristics of 1985 Programs for International Training" and "Ways and Techniques to Improve International Training." These concepts were edited and circulated to the 46 participants of the seminars. The participants were asked to indicate their judgment as to (1) the "likelihood" of the characteristics occurring and (2) "priorities" of the ways and techniques to improve international training. A tabulation of the responses is shown in Tables 1 and 2.

These responses suggest that:

- Funds for international training will decrease;
- The mix of LIC students in U. S. universities will shift, with an increase in Ph.D. candidates and a decrease in M.S. candidates;
- The number of U. S. institutions offering Ph.D. work for LIC students will not decrease;
- The need for agricultural economics training of subprofessionals and nonformal training will expand; and
- There will be greater communication among professionals of LIC and the developed countries.

How is it possible for respondents to expect funding to decrease while expecting increasing involvement of U. S. institutions and more dialog among professionals of the LICs and the developed countries? Perhaps this resulted from the way in which the questions were posed. On the other hand, it may be based largely on a lack of concern about the expected decreases in funds or optimism that if international training is improved, increased funding will be forthcoming.

The following techniques for improving international training were given highest rankings by those responding.[3]

- More professional links of LIC graduate students to home country during graduate training;
- Increased follow-up with former LIC graduate students after they return home;
- Development of a small-grants program; and
- Additional professional dialog of U. S. and LIC professionals through workshops and postdoctoral opportunities for LIC graduates in developed countries.

Implementing these suggestions will obviously require additional and more flexible funding. Hence, the expectation of decreased funding is inconsistent, not only with other developments

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[1] Three seminars composed of members of the Association and other interested individuals plus a series of specially prepared papers were central to the review. Of great importance in facilitating the seminars and the dialog essential to the review was a grant from the Rockefeller Foundation.

[2] To a large extent, the recommendations incorporated in this paper are a synthesis of those developed by the seminars. Thus, this paper owes much to the members of the International Committee and to the many others who participated in the seminars. On occasion the recommendations of this paper go beyond those articulated during the seminars. Thus, responsibility for any errors of logic, fact, or feasibility of the recommendations rests with the authors. Further, the recommendations incorporated in this paper do not represent at this time the recommendations of the International Committee. Discussions at the 1974 AAEA Annual Meetings and further deliberations of the International Committee will determine which ones are embraced by the Committee.

[3] Each respondent was asked to identify six of the 18 suggestions noted in the earlier seminars as "highest priority," six as "medium priority," and the remainder as "lowest priority."

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Table 1. Anticipated characteristics of 1985 programs for international training in the economics of agriculture of developing countries

	Percent of Respondents rating characteristic as:			
Characteristic	Most Likely	Likely	Not Likely	Highly Unlikely
1. Funds for related training in U. S. universities will decrease.	24	59	17	
2. Funding for university training in the LIC will rise, although wide immobility of students among countries will persist.	31	66	3	
3. The demand by LIC students for a U. S. M.S. degree will decrease.	24	45	17	14
4. The demand by LIC students for a U. S. Ph.D. degree will decrease.		22	39	39
5. There will be more effective selection of LIC students attending U. S. universities.	10	66	24	
6. There will be increased training at the International Research Institutes such as CIAT, IRRI, and CIMMYT.	21	51	28	
7. Fewer U. S. institutions will be offering Ph.D. work for LIC students.	11	29	46	14
8. Training in U. S. universities will increasingly focus on rural development and therefore, be more relevant to the LIC student.	4	30	62	4
9. Research opportunities in the LIC will be increasingly difficult to arrange.	10	45	41	4
10. There will be increased need for training of subprofessionals.	25	61	11	3
11. Demand for short courses conducted in the LIC and in the United States will expand.	25	61	14	
12. More regional journals will be prepared and more widely distributed.	18	71	11	
13. There will be more two-way communication among professionals of LIC and the developed countries.	29	61	7	3

expected by 1985, but also with the program suggestions given highest priority.

Major Recommendations

We have pondered the suggestions given highest ratings and have concluded that several institutional changes will be necessary to realize these suggestions within this decade. In turn, we make the following major recommendations:

Broaden the decision making for training programs financed by international agencies;

Increase the funds for international agricultural research and education by a quantum amount;[4]

Foster regional organizations to stimulate and facilitate professional growth and development of agricultural economists in selected regions of the LIC; and

Develop additional flexibility within U. S. training institutions.

Broaden the Decision Making

To improve and extend home-country theses, postgraduate follow-up, subprofessional and nonformal training, and professional dialog on a wide scale will require a great many decisions. Many of the needed decisions are particular to the individuals and institutions involved and often cannot be anticipated. In many cases, improvements require only small amounts of money, yet may be crucial to the training process. The division of labor between the funding agencies and the training institutions needs to strike a better balance than is the case today. Our judgment is that more of the decisions now made by the funding agencies should be relinquished in favor of the training institutions.

Unfortunately, the funding procedures and fund limitations for participation in international training and research have led to highly centralized decision making about activities such as thesis research in home countries. Congressional attitudes, limited availabilities of management time in funding agencies, and dispersion of

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[4] We intentionally encompass research as well as education. In our judgment the educational abilities of university personnel are enhanced greatly if these persons can also participate regularly in related research activities.

Table 2. Ways and techniques to improve international training in the economics of agriculture of developing countries

Ways and Techniques	Percent of Respondents rating ways and techniques as:[a] Highest	Medium	Lowest
1. Develop greater linkages between research of LIC graduate students in United States and actions programs of LIC.	62	31	7
2. Improve existing Ph.D. programs at 6–8 U. S. institutions with agreement on specialization of geographic areas of LIC.	14	31	55
3. Content of training should continue to emphasize theory and quantitative techniques, but should be broadened to include attention to institutional framework of development, as well as "unsophisticated" methods of analysis; e.g., farm budget studies, simple regression, and so on.	54	39	7
4. Provide students who lack a background in practical agriculture some basic information to fill this void.	7	38	55
5. Provide for a follow-up of Ph.D. graduates through first six years on the job, rather than casting loose upon graduation.	59	28	13
6. Facilitate access by LIC students to data and research reports on LIC countries already at U. S. universities, USDA, and AID.	36	50	14
7. Encourage LIC government support of thesis research.	45	52	3
8. Encourage more funding for field work for LIC students.	66	28	6
9. Develop small grants program for U. S. professionals and LIC counterparts, perhaps administered by AAEA.	52	38	10
10. Develop greater emphasis on workshops and other techniques to foster communications among equals from LIC and the United States.	52	41	7
11. Give support to programs which link 5–10 individuals in different countries, rather than institution-wide participation in cooperative international development programs.	30	35	35
12. Facilitate courtesy appointments of LIC professionals at U. S. universities.	10	52	38
13. Enlarge contacts of U. S. institutions beyond agricultural institutions of LIC.	10	34	55
14. Increase and enhance post-doctoral opportunities in the United States and other countries and arrangements for LIC professionals.	59	31	10
15. Develop better system for evaluating academic records of LIC students applying to U. S. universities.	24	31	45
16. Develop international standards for all Ph.D. degree programs.			100
17. Develop a handbook with suggestions and guidelines for departments receiving LIC students.		17	83
18. Develop journal exchanges.	17	35	48

[a] Respondents were asked to select 6 for the "highest" category, 6 for the "medium" category, and 6 for the "lowest."

responsibilities among regional and functional offices have contributed to these rigidities.

Responsibilities and authority currently given to universities regarding decisions on such matters as travel for research supervision, follow-up with former students, and follow-up of previous research activities are extremely limited. Inflexibility by funders on the time required by students to attain given levels of competency is a further cause of difficulty.

The magnitude of the problem is underscored by data developed by Stevenson [12] and Sperling [11]. Almost 30 percent of the students entering graduate degree programs in the "economics of agriculture" in the 1969–1973 period were from the LIC. Almost one-fourth of these were sponsored by the Agency for International Development (AID) and another one-sixth by foundations or other nonprofit agencies [12]. Sperling's data show that over 50 academic institutions and an equal number of nonacademic institutions have been involved in the training of AID participants in agricultural economics [11].

Three steps might be taken to bring about decentralization:

AID, Foundations, the Department of Agriculture (USDA), and the universities should examine the balance of decision-making responsibilities with a view toward shifting more decisions to those institutions doing the training;
A small-grants program should be initiated; and
A program of automatic allocation of money to universities for research and education related to tropical agriculture should be developed.

Discussions in the seminars repeatedly identified instances where a few hundred dollars would make the already approved expenditures for training and technical assistance much more productive. The difficulty of justifying and obtaining approval for this kind of expense has deterred many trainees from requesting it. We are convinced of the merits of these kinds of expenditures, but we do not think they can be handled effectively in the present centralized systems.

Given the overwhelming role of AID in the training process, we propose that AID finance a supplementary small-grants program in agricultural economics along the following lines:

Extend a block grant to the Social Science Research Council;
Indicate general policy for the use of such funds. Possible guidelines might specify that:
  Monies would be used to support activities supplementary to regular training, follow-up work after return of LIC students to their home countries.
  Grants would be quite limited in size and duration.
  Allocation of grants would take into account other assistance available, financial need, and potential contributions to the research base of the home country.
  Funds would cover travel and per diem of Americans, so long as the activities contributed *substantially* to the training of LIC persons.

A precedent for this approach is AID's financing of the Research and Training Network carried out by the Agricultural Development Council (ADC). ADC officers and seminar leaders make the many decisions required for the effective conduct of the program. Another example is USDA's approach in agricultural education and research. A prominent feature of the USDA pattern has been the automatic allocation of Federal monies to universities—a recognition by the central agency that a large number of the program decisions are necessary to serve the diverse interests of U. S. agriculture. It also reflects the power of the U. S. agricultural interests in assuring a geographic dispersion of funding [13]. Some, like Hightower, argue that the funds are used for the wrong activities [6], but adjustments may not be any quicker under a centralized approach.

Increase the Funds for International Agriculture Research and Education

Excellence in U. S. training in the economics of agriculture of the low income countries necessitates involvement in related research. Opportunities for international research have decreased during the past decade and are expected to diminish even further under present programs. Thus, in terms of the objectives of U. S. training, we see a need for expanded research opportunities and stronger professional links among the social science research centers in the LIC and those in the United States. However, a substantial expansion in economic research is not likely unless it is a part of an overall expansion of broad-based research in agriculture.

There are, of course, other reasons why international agricultural research should be expanded. Evenson documents the small expenditures for agricultural research in the LIC compared with the funds expended in the developed countries [3]. The outlays in LICs appear even more inadequate when pitted against the increased LIC demands for food and fiber associated with increasing populations and rising incomes. Thus, we propose a sharply expanded support of international research and education.[5] Additional research and education focused on tropical and subtropical agriculture would also benefit the United States. In light of the developments outlined below, there are needs for greater international dimensions in the training of U. S. students and in agricultural research carried out by U. S. scientists.

Several developments support this judgment:

The increasing interdependence of U. S. society with world developments, with implications for the type of university training "needed" by U. S. students [14];
The potentially stronger trade and political effects that the LIC may exert on the U. S.;
The close interaction of U. S. and international markets for agricultural goods;
The accelerating improvements in communica-

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[5] This proposal is not intended to detract from significant needs for international assistance to national research efforts of the LIC.

tions and transportation, leading to closer contacts by Americans with people of other countries; and

Increased investments by international centers and national governments in tropical agricultural research, giving rise to important research findings that are relevant for U. S. technology and social problems.

Again, we argue for a decentralized decision-making approach and suggest automatic allocation of Federal money for research and education on LIC agriculture.

The distribution of funds might be based on:

Total number of students;
Number of students from LIC;
Course offerings related to purpose of program and enrollment in these courses; and
State or other supplemental funds used to support research and educational activities similar to those encouraged by this program.

Activities might be varied and at the discretion of university officials. So long as consistent with the overall mandate, these might include course development, research, adult education, instruction of resident undergraduate and graduate students, thesis supervision, follow-up with former students from LIC, seminars, and books. We propose, however, that use of funds for construction, repair, and upkeep of buildings, laboratories, and equipment be prohibited. Further, the new funds would be supplementary and would not be used to replace similar programs now financed by international agencies.

This type of program could, sometimes with minor changes in legislation, be made part of programs carried out by AID, Health, Education and Welfare (HEW), or USDA. We have not explored all the possible options, but AID in particular ought to have a strong institutional interest in this approach. Another option would be an expansion of the program of research and education on tropical and subtropical agriculture authorized by Section 406 of Public Law 480. Amendments to Public Law 480 made in 1966 included a budget authorization of $33 million to the Secretary of Agriculture for carrying out research and education related to tropical and subtropical agriculture.[6] Contracts, cooperative agreements, and grants to colleges and universities in the United States are already provided for within that legislation [10]. To date, however, there has been only one appropriation for this program—$500,000 in fiscal year 1974. The latter funds are being used to finance cooperative agreements with the universities of Puerto Rico, Hawaii, and Florida, as well as selected research in Puerto Rico by the Agricultural Research Service of the USDA.

Encourage Regional Organizations Designed to Facilitate Professional Growth in LIC

Several factors give rise to the recommendation to promote regional organizations which would facilitate professional growth of agricultural economists. In many countries there is a significant but limited number of trained agricultural economists. Many of these persons are searching for their specific role. The regional organizations could help to overcome problems associated with isolation and limited funds that prevent active professional interchange. But building closer relationships is a long-term process under the best of circumstances. Reactions to past instances of intellectual colonialism will impede and make more difficult the effective development of these organizations. However, we think the potential benefits are worth the effort. The experience of the Agricultural Development Council in Asia illustrates payoffs from "network" types of activity [1]. The work of Michigan State University in Africa has similarities, as do some foundation activities in Latin America [2].

In implementing this type of recommendation, national and regional organizations of agricultural economists and the International Association of Agricultural Economists should not be overlooked. Olatunbosun's discussion [9], for example, indicates that regional organizations of agricultural economists may be in a position to play a crucial role in developing linkages and networks of communications that will facilitate professional growth in the LIC.

The activities of such regional organizations would vary, but might include:

Follow-up with students who return to their home countries after studying in the United States;

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[6] Legal interpretation would be necessary to determine if legislation would need to be amended to carry out the approach outlined above. Also, other legislation could be developed. However, consideration of the budget process would seem to argue for use of current or slightly modified authority contained in Section 406. There is, of course, the danger that the appropriations under this approach would be so small that the automatic allocation would dissipate any potential impact simply because there would not be a critical mass at any one university. Further, there is a chance that the universities would not use the funds as intended. These chances would seem worth taking.

Workshops and seminars;
Facilitating arrangements for sabbaticals; and
Facilitating professional dialog among agricultural economists of a region and with agricultural economists outside the area.

This recommendation should not be interpreted as calling for substitute organizations. The Association should not be hesitant to support and enhance successful features of current regional activities.

Flexibility of U. S. Training Institutions

Implicit in our recommendation for decentralization of decision making is greater flexibility of the national and international funding agencies. There is a corollary also of great importance—increased flexibility by the U. S. training institutions. More decision making by the training institutions about training programs of LIC students should also mean some adaptation of training programs to the particular needs and circumstances of those receiving the training.

The needs for flexibility especially relate to:

The need to adapt to the improved capabilities of LIC universities; and
The need for development of nonformal short courses.

As Fienup indicates, there have been significant changes in the capabilities of LIC universities [4]. An increasing number of LIC universities have developed high quality M.S. programs and, in some cases, Ph.D. programs. Consequently, U. S. universities will increasingly be asked to admit holders of M.S. degrees from LIC universities.

In many cases the selection of U. S. and LIC students for U. S. Ph.D. programs has been based on the record of M.S. training in U. S. universities. Formal and informal linkages have made possible intelligent consideration of applicants. These linkages have in some cases also made possible an awareness of the content of the courses that the applicant has taken to fulfill the M.S. requirements. Substitute means of obtaining information for use in considering applicants will be required. It may also be necessary for the universities to be flexible about the initial part of the Ph.D. training program for these students to accommodate to their previous training. Summer programs such as those conducted by the Economic Development Institute, offering incoming students selected course work, may also be an important approach to these changes.

There are other prospective developments which will call for flexibility. An increasing number of LIC students will be asking to take Ph.D. course work at U. S. universities to contribute to requirements of a Ph.D. in their home countries [8]. In other situations, they will be asking for postdoctoral training opportunities after receiving Ph.D.s from their LIC universities. In many cases, changes of U. S. graduate rules will be needed.

Steps might also be taken to include LIC economists on committees guiding home country dissertations of LIC Ph.D. candidates at U. S. universities. Many of these economists are highly capable and, especially in terms of home-country theses, have a great deal to contribute.

In yet other situations, foreign students may need to do their theses at U. S. universities with staff familiar with their country and with needed library resources on their country. These universities may not be the ones from which they are receiving their degrees. Again, unusual flexibility is called for if there is to be maximum payoff to foreign student training.

The importance of non-degree training opportunities is not generally recognized. Promotions into administrative positions have come quickly for many who return to LIC. Formal course work in some cases has not focused on the particular needs in the home countries. In other cases, degree recipients of earlier years have needs for additional study which are often not available in formal academic programs. Thus, there are frequent needs for skills and knowledge not ordinarily incorporated into U. S. or other graduate training programs in agricultural economics.

Flexibility is again required if nonformal training is to be complementary with formal training available in the LIC or in the United States. Further, these types of activities increasingly need to be conducted at institutions in the LIC. Course content needs to be adapted to the particular country situations, and staff responsibilities among LIC economists and Americans need to be effectively intergrated.

Some short courses can be complementary to the formal academic training of LIC students at the time they are obtaining their degrees. In other cases, the more appropriate timing is after they have returned to their country and have worked for a period of time. Further, the benefits of LIC (and American) students learning about techniques of agricultural production should not be overlooked. Programs developed at the international research centers such as the international rice and wheat centers (IRRI and CIMMYT) could be utilized to the advantage of many agricultural economists, especially those who have not been involved directly in the production of agricultural products.

The World Bank (IBRD), USDA, and AID have been active in these efforts. Participation by U. S. universities has been more limited, although there are significant exceptions [5]. The greater involvement of IBRD, USDA, and AID personnel in these types of programs stems from the focus of their professionals with policy, program, and administrative problems. These organizations also have more flexibility to fit nonformal training programs into their activities than do most universities. Thus there appears to be significant opportunity for greater cooperation among USDA, AID, IBRD, and the universities in the preparation and presentation of nonformal training courses.

The improved capabilities of LIC universities and the need for nonformal short courses raise questions about the degree orientation of U. S. universities. Wunderlich argues that degree requirements limit the flexibility of educational institutions; he also explores the implications of eliminating the "terminal degree concept" [15]. Most universities are not likely to go this far. But surely the educational changes in the LIC justify a close examination by U. S. universities of accommodating more non-degree activity by their faculty and their students.

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The review sponsored by the Association points up the inconsistency between (1) the expected decrease in funds and (2) the expected increased involvement and relationships among U. S. and LIC institutions and professionals. We judge that the expected involvement can be realized, but not without additional funds and significant changes in the way that training is approached.

Broadened decision-making, increased funds, regional organizations, and increased flexibility will be required. There are undoubtedly other recommendations that merit support. And the above guidelines will surely require refinement.

Active efforts will be required to close the gap between what would otherwise happen and the hopes of the membership. The Association obviously confronts the question of whether it should actively advocate the implementation of these and other related recommendations. Our question is—if it does not, then who will?

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Session 13

TRAINING IN INTERNATIONAL AGRICULTURAL DEVELOPMENT: THE ROLE OF THE AMERICAN AGRICULTURAL ECONOMICS PROFESSION

Discussants: Emery N. Castle, Oregon State University; Roger W. Fox, University of Arizona

CONTRIBUTED PAPERS

(Abstracts)

CHAIRMAN: JOSEPH D. COFFEY, VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

GROUP I—PRODUCTION ECONOMICS

Chairman: Luther H. Keller, University of Tennessee

P. G. Allen and R. E. Howitt, "The Allocation of Research and Extension Expenditures in Agriculture."

A theory of the interdependence of extension and research expenditures on raising productivity is developed and applied to aggregate California agricultural output. To permit greater flexibility, a distributed lag on research with a polynomial head and exponential tail was used. Present values of one dollar of research of $302 to $321 at 12 percent discount rate were obtained. *University of California.*

Hovav Talpaz and Itshak Borosh, "Strategy for Pesticide Use: Frequency and Application."

A pest control model with multiple treatments is presented. Population dynamics and damage rates are temperature dependent with predation affected by pesticide application. Pesticide tolerance distribution is used for constructing the estimated kill function. Mathematical-numerical optimization is applied, selecting frequency and dosage which minimize control costs and crop damage. *Texas A&M University.*

M. Dean Ethridge and Fred C. White, "Minimizing Expected Disequilibrium Costs with Uncertain Production and Utilization."

A theoretical framework is developed for optimizing planted acreage under yield and utilization uncertainties, the objective function being expected disequilibrium cost. Empirical application is demonstrated for peanut seed acreage in Georgia. Results indicate usefulness of the methodology for dealing with uncertainties in matching agricultural crop supplies with demands. *University of Georgia.*

Edgar J. Ariza-Nino and Harlan Hughes, "Formulating Profit Maximizing Beef Rations—A New Approach."

What rate of gain should a cattle feeder strive for? This paper presents a simple iterative procedure to determine the rate of gain most profitable per day for growing beef cattle, and the least-cost ration necessary to satisfy its corresponding nutrient requirements. *University of Wisconsin-Madison.*

Jerry A. Sharples and Rodney Walker, "An Analysis of Shifts in Cropland Use in the North Central Region."

An empirical model is presented that accurately estimates row crop and extensive crop acreage in the North Central Region. It shows (a) for each one-acre increase in diversion, row crops decrease 0.62 acres and extensive crops decrease 0.12 acres, and (b) the annual shift to row crops is diminishing. *Purdue University.*

GROUP II—MARKETING

Chairman: Edward Uvacek, Jr., Texas A&M University

Dennis P. Helmreich and Bill R. Miller, "User Acceptance of a Clearinghouse for Trading Eggs."

Tabular and regression analyses are utilized in conjunction with discriminant analysis to determine user acceptance of the services of Egg Clearinghouse, Incorporated. The results provide fundamental information required to project the level of demand for such marketing services in the future. At least one-half of existing firms in the industry are categorized as potential users of egg clearinghouse services. *University of Georgia.*

Robert N. Wisner and J. Marvin Skadberg, "Commodity Futures Markets—Are Changes Needed?"

The usefulness of commodity futures markets for hedging is affected by delivery conditions, contract size, and related contract details. Impediments to delivery or contract specifications designed primarily for large hedgers can reduce competition in such markets, thus lowering risk-shifting performance under certain conditions. Reduced risk-shifting performance was evident in grain futures markets in 1973. *Iowa State University.*

John N. Ferris, "Use of Ratios and Gross Margins in Time Series Supply Analysis."

Gross margins provide a means to (1) incorporate more *a priori* information into time series supply analysis and (2) consolidate two or more variables into one. Implicit in applying ratios are certain restrictive assumptions. The statistical fit of "gross margin" equations on five commodities compared favorably with "ratio" and "separate variable" formulations. *Michigan State University.*

David E. Kenyon and R. Sam Evans, "Soybean Acreage Response Analysis Including Policy Variables."

National and regional acreage supply functions are developed for soybeans utilizing data from 1948 to 1973. Particular attention is given to the measurement and analysis of the effects of government commodity price-support programs on harvested soybean acreage. Detailed attention is given to the effects of the feed grain programs of the 1960s and to the set-aside programs of 1971–73. The main emphasis is placed on the calculation of "effective" prices of soybeans and competing crops and the ability of the model to project harvested acreage six–nine months in advance. *Virginia Polytechnic Institute and State University.*

J. Bruce Bullock, "Examination of Market Data for Evidence of Shifts in Consumer Preferences: A Look at Beef, Pork and Chicken."

This paper develops a method of using market data to test hypotheses about shifts in consumer preference structures. The analysis shows that the partial preference structure for meats shifted in 1959. The nature of this change was an upward shift in the preference for beef relative to pork and chicken. *North Carolina State University.*

GROUP III—LAND USE POLICY

Chairman: William H. Heneberry, ERS-USDA

Sandra S. Batie and Burl F. Long, "Looking Before Leaping: Land Use Legislation and the Need for Economic Analyses."

Continuing public interest in land use controls has provided a need for information as to the impact of public land use regulations upon regional distributions, resource allocation, and economic growth. This need implies opportunities for research addressing the benefits and costs of controls, as well as the distributional impacts of such legislation. *Virginia Polytechnic Institute and State University.*

Harold D. Guither, "Policy Issues in Reclamation of Strip Mined Land in the Midwest."

Nearly half of U. S. coal output comes from strip mines. Key policy issues dealing with strip mining and preservation of agricultural lands include: whether stripping should be prohibited, use of land before and after stripping, the extent of reclamation required, reclamation of earlier mined lands, and effects upon tax revenues. *University of Illinois.*

Jack D. Edwards, "Regional Land Use Decision Criteria for Public Resource Planning."

This paper describes land use changes occurring on the National Resource Lands and assesses major forces influencing them. A regional framework to evaluate land use change is outlined based on experience gained in the Bureau of Land Management's planning efforts. Finally, prospects for incorporating the regional approach are evaluated. *Bureau of Land Management, United States Department of the Interior, Denver, Colorado.*

A. Stewart Holmes, "Land Use Controls, Interstate Energy Systems and the National Interest."

Existing and future state land use legislation is likely to control certain energy facilities. Such control can be in conflict with the national interest due to the interstate nature of U. S. energy systems. Economic factors relating to this conflict include accounting stance, trade-offs, and the reciprocal nature of externality problems. *Federal Power Commission.*

Stan Wilson, "Land Use/Resource Inventory Systems: An Information Paradigm."

The fundamental concepts of information theory are used to construct a conceptual framework for the creation and operation of land use and/or natural resource inventory systems. Such a framework is the initial step in creating a general theory of inventory systems. Several systems exist without a theory. *Texas A&M University.*

GROUP IV—PUBLIC ISSUES IN RURAL DEVELOPMENT

Chairman: Dale Colyer, University of West Virginia

Jerome M. Stam and Thomas F. Stinson, "Voluntary Labor and Nonmetropolitan Local Government: Some Considerations."

Volunteer work is an important facet of American life, especially in rural America. This paper develops and discusses models of consumption and production which include volunteer time. The current revenue sharing formula which incorporates a tax effort factor is shown to discriminate against communities choosing to provide services by using volunteer labor. *ERS-USDA.*

Fred J. Hitzhusen, "Federal Revenue Sharing: Some Implications for Rural Communities."

Federal revenue sharing may be biased against rural (small) communities due to the omission of user charges and volunteer effort from the "tax effort" component of the allocation formula. The substitution of user charges for general revenue financing and volunteer for paid effort in many rural (small) communities results in reduced Federal revenue sharing payments. *Ohio State University.*

Paul Fuglestad, "The Use of Discriminant Analysis to Estimate Intercounty Flows of Public Funds."

Varying geographic patterns of state and federal fiscal activities result in tax flows among counties. These flows can be determined only through enormous effort in the compilation of large sets of government financial data. A procedure is proposed where discriminant analysis is used to estimate intercounty tax flows, reducing considerably the effort involved. *ERS-USDA.*

Edmond E. Seay, Jr., "Restructuring Support of Extension CRD Programs for Greater Effectiveness."

The paper postulates that the structure of many Land Grant Universities is inimical to the needs of extension CRD programs. Suggestions are made for alleviating this condition through providing access to a broader array of competencies, assembling the critical mass of manpower needed, and improving information retrieval. *University of Rhode Island.*

Richard J. Mikes and Douglas C. Braithwaite, "Rural Development, An Idea Whose Time Has Arrived?"

Rural development advocates have yet to mobilize broad-based organized support. The magnitude of the challenge requires this if the nation is to generate a comprehensive national policy encouraging a system of interdependence between rural and urban sectors. This paper explores the dynamics involved. *University of Georgia.*

GROUP V—INTERNATIONAL TRADE

Chairman: J. T. Scott, Iowa State University

Mitoshi Yamaguchi and Hans P. Binswanger, "The Role of Sectoral Technical Change in Development: Japan 1880–1965."

The size of the effects of sectoral technical change in Japan are examined in an agricultural-nonagricultural two sector general equilibrium model with market imperfections. The growth contribution of agricultural technical change was always smaller than the one of nonagricultural technical change, and it declined during the period of the investigation along with the decline of the share of agriculture in Net National Product. *University of Minnesota and Agricultural Development Council, Inc.*

F. S. Bagi and I. J. Singh, "A Microeconomic Model of Farm Decisions in an LDC: A Simultaneous Equation Approach."

The purpose of this study is to identify and understand the interdependent nature of farm decisions in developing agriculture. These include production, consumption, investment, and financial decisions carried out by firm-households in LDCs. A microeconomic simultaneous equation system is used to specify the behavioral relationships that can be estimated using limited or full information methods. *Ohio State University.*

Phillip E. Church, "The Cost-Effectiveness of Providing Agricultural Extension Services in a Developing Country: The Case of Costa Rica."

Costa Rica has limited public resources available for the transfer of new technologies by its Extension Corps to farmers. To evaluate the effectiveness of these Extension resources, a modified cost-benefit approach was used. The broad application and simplicity of this method make it a promising management tool. *U. S. Agency for International Development.*

Roger Fox, "Developing Centers of Excellence in Agricultural Economics: The Case of the University of Ceara, Brazil."

The Master's degree program in Agricultural Economics started in 1971 by the University of Ceara is reviewed and specific problems associated with its early operation are discussed. General issues raised by the experience are presented in the expectation that the conclusions will be useful in planning and initiating new graduate programs in developing countries. *University of Arizona.*

Richard L. Meyer and Charles L. Wright, "Fertilizer Prices and Brazilian Agricultural Development."

Recent fertilizer price increases have serious implications for LDCs that have come to rely upon reasonably priced imports. Research on yield response to chemical fertilizers on several crops in Brazil gives mixed results implying (1) the need to reevaluate present fertilizer subsidies and (2) potentially little effect of fertilizer price increases on agricultural modernization in Brazil. *Ohio State University.*

GROUP VI—METHODOLOGY

Chairman: Milton C. Hallberg, Pennsylvania State University

V. Glenn Chappell, Jr., "Determining Economic Sub-Areas With Principle Component Analysis."

Principal component analysis is used to incorporate the effects of several socioeconomic variables into an index of regional socioeconomic change. The index is then used as a basis for delineating economic sub-areas within the Tennessee Valley region. *Tobacco Tax Council-Richmond.*

Terry L. Crawford and J. Gerald Feaster, "Methodology for Estimation of Variable Cost, Joint Cost, and Profits for Individual Products in Retail Food Stores."

A methodology was developed for estimating cost components at the retail level for major departments and individual food products. The methodology consisted of 4 phases: estimation of margins by store, departments, and products; derivation of direct variable costs for products; allocation of semi-joint space and equipment cost; and allocation of residual joint overhead cost and profit to departments and products using the contribution margin approach. *ERS-USDA.*

Wen S. Chern, "Measuring the Impact of Generic Advertising on Import Demand for U. S. Frozen Concentrated Orange Juice in Canada."

The geometric lag model is shown to be superior to the arithmetic lag model for estimating the impact of advertising. The results show that both short-run and long-run advertising elasticities are less than unity at current expenditures. The study concludes that more spending is necessary for the advertising activities to be profitable. *Oak Ridge National Laboratory.*

Bill R. Miller and Clifford M. Carman, "Improvements in Efficiency Measures Derived from Farm Tax Records."

Two levels of input aggregation are compared as a means of introducing rigorous efficiency measures into traditional farm business analysis of dairies in farm record systems. Using a technique developed by M. J. Farrell, economic efficiency is partitioned into technical and price efficiency. A seven-variable aggregation of commonly observed dairy inputs appeared to provide reliable management direction for reorganizing input use. *University of Georgia.*

Paul K. Kau, "Estimating Bounded Regression Functions and the Hybrid Multivariate Probit Application."

This paper explores major methodological problems encountered in estimating various types of bounded regression functions, discusses their alternative approaches, and compares their statistical properties. It also suggested a generalized model capable of handling various kinds of bounded regression problems and demonstrated its applicability to agricultural economic research. *Alcorn State University.*

GROUP VII—ISSUES IN WATER RESOURCE POLICY

Chairman: Paul Barkley, Washington State University

Clyde F. Kiker, "Water Rights Under a Statutorily Modified Riparian Doctrine."

The Florida Water Resources Act changes many rights enunciated under riparian doctrine. Public interest considerations are dominant, with administrative discretion playing the major role in water allocation to private users. No mechanism for allocating water to the most economically productive uses is provided. The author considers two possible modifications. *University of Kentucky.*

Ronald M. North, "The Net Economic-Environmental Impact of Small Watershed Projects."

An analogue method of *ex post* evaluation of small watershed project performance is demonstrated for watersheds with projects versus those without projects. Benefits are measured directly as production gains or losses. *Ex post* economic and environmental values are integrated directly from land use changes and from surrogate land value changes. *University of Georgia.*

Leonard A. Shabman, "Cost Sharing Arrangements for Inland Waterway Transportation."

User charges on inland waterways should promote the goals of economic efficiency, equity, and cost-recovery. Conflicts between criteria can be minimized by levying charges on commodities with lowest absolute value of price elasticity of demand and supply. However, study of market forces influencing water transportation are necessary before recommending any user charge system. *Virginia Polytechnic Institute and State University.*

Craig L. Infanger and Walter R. Butcher, "Individual Income Redistribution and Publicly Provided Irrigation: The Columbia Basin Project."

The performance of publicly provided irrigation as a tool of income redistribution is examined by applying fiscal incidence analysis to a representative area in the Columbia Basin Project. Results indicate the redistributional impact of public irrigation is clearly not in favor of lower income classes. *University of Kentucky and Washington State University.*

Robert B. McKusick and J. Herbert Snyder, "The Not So Efficient B/C Analysis—Inconsistency and Resource Supply and Demand."

Economic evaluations by public agencies based on Benefit Cost Analysis (B/C) have been as varied as the number of agencies making the studies. The paper discusses how economic analysis for project evaluation can be consistent with an overall theory of resource planning and development if planners accurately consider resource demand and supply relationships. *ERS-USDA and University of California.*

Group VIII—Impact of Tranportation Reorganization on American Agriculture

Chairman: C. Phillip Baumel, Iowa State University

Richard L. Kilmer, "Is Current Transportation Policy Consistent With an Optimal Transportation System?"

Buchanan-Tullock collective choice model is used to analyze decision rules whereby individuals choose between market management and regulated market. Conclusions: the public would choose market management. Reasons given for continuance of regulations: interest group dominated legislators and regulatory agencies. Result: current policy is not tending the transportation industry toward optimality. *Ohio State University.*

A. R. Bunker, "Impact of Rail Abandonment on Agricultural Production and Associated Grain Marketing and Fertilizer Supply Firms."

A detailed analysis is made of two rail line abandonments in a rural corn belt region. The study describes the impact that the abandonments have had on the operations of grain elevators, feed distributors, and fertilizer distributors. Firms losing rail service are compared with nearby firms which have not lost rail service. *University of Illinois.*

Walter J. Wills, "The Regional Rail Reorganization Act of 1973."

The Regional Rail Reorganization Act of 1973 if implemented as now planned will make many changes in approaches to rural development. Agricultural economists throughout the U. S. should be aware of the challenges the approach used presents to sound decision making. It is suggested the American Agricultural Economics Association take the leadership in organizing a national task force to develop guidelines for a national transportation policy. *Southern Illinois University.*

Ronald E. Deiter and James W. Gruebele, "Improving the Performance of Bulk Milk Assembly."

Route inefficiencies in milk procurement continue to exist. A primary reason is that routes are planned by contract haulers rather than by cooperatives who fear unionization. Also, spatial monopsony could result from increased efficiency. The article suggests several solutions including the education of haulers regarding benefits from restructuring routes. *University of Illinois.*

Group IX—Delivery of Services to Rural Areas

Chairman: Frank Bordeaux, University of Kentucky

David L. Debertin and John M. Huie, "Socioeconomic Determinants of the Demand for Inputs to the Educational Production Process."

Interrelationships between socioeconomic characteristics of communities and the availability of inputs to public education were examined for Indiana schools during 1970–71. The analysis revealed that family income levels were highly related to salaries of teachers, while assessed valuation was of importance in determining pupil/teacher ratios. The enrollment of the school was the primary determinant of the availability of course offerings at the secondary level. Teachers holding graduate degrees tend to be found in communities where a high proportion of the population graduated from college. Teachers at high mean experience levels resided in low-income communities and in communities where a high proportion of the population was over 65. *University of Kentucky and Purdue University.*

David W. Holland, John Baritelle, and Greg White, "The Impact of Transportation Costs Upon Optimal School Size and Location in Sparsely Populated Rural Areas."

The objective of this study was to investigate the relationship between internal schooling economies and transportation diseconomies with regard to consolidation of rural schools. The consolidation question was conceptualized as a programming problem where the objective was to minimize the sum of schooling and transportation costs. Both linear and separable programming models were used. Model solutions indicated that some consolidation of schools in the study area would minimize costs, but total cost savings were surprisingly small. *Washington State University, ERS-USDA, and Washington State University.*

Leon B. Perkinson, "Distance Traveled to Obtain Medical Services in a Selected Rural Area."

Average one-way miles traveled by residents of a densely settled, rural area of North Carolina to obtain selected medical services are analyzed. Rural residency and race (but not income) were important but have opposite effects. Mileage traveled increased as the destination's population size increased. *ERS-USDA and North Carolina State University.*

Gordon R. Sloggett, David O. Oboh, and Daniel D. Badger, "Some Social and Economic Impacts of Rural Water Districts."

Water systems sponsored by the Farmers Home Administration have had a significant impact on improving quality of life, as well as stimulating economic activity in rural areas. In this study of 57 rural water districts in Oklahoma, the average annual rate of growth of new customers was over 10 percent. *ERS-USDA, Midwestern State Government of Nigeria, and Oklahoma State University.*

Robert C. Munson and Arlo Biere, "Police Protection in Rural-Oriented Cities."

While certain social factors appear to influence the crime rate, police expenditures—as a measure of presence of police—and the apprehension rate did not significantly influence crime rates. Per capita police expenditures are weakly correlated with factors expected to influence costs. Failure to detect economies of scale may be because larger communities increase police expenditures to handle the additional crime associated with agglomeration. *Kansas State University.*

GROUP X—THE INFLUENCE OF AND PRIORITIES FOR PUBLIC PRICE AND INCOME POLICY RESEARCH

Chairman: Daryll Ray, Oklahoma State University

C. T. Chen, W. B. Justice, and J. T. Scott, Jr., "The Pattern of Income Distribution in the United States: 1963–72."

An advance movement into higher income classes by a significant proportion of families in the United States during 1963–72 was identified. However, the family income distribution has remained, for all practical purposes, relatively stable. The average years a family stays in one income class is relatively short. *Midwestern University and University of Illinois.*

A. B. Lewis, "Relation of the Cost-Price Squeeze to the Reduction in Number of American Farms."

Farm price relationships were so unfavorable from the early 1950s through 1971 that only with the disappearance of nearly one-half the farms and their consolidation with the survivors, with a great increase in farm mortgage debt, was it possible for remaining farmers to achieve incomes competitive by American standards. *Agricultural Development Council Inc.*

Donald K. Larson, "Economic Class of Farm and the Farm Family Welfare Myth."

In the past it was reasonable to believe that farm family well-being was tied closely to size of farm business. But the increasing trend toward off-farm sources in recent years makes size of farm business a poor measure of farm family well-being. Yet level of farm income is still used for that purpose. *ERS-USDA.*

L. Don Lambert, "The Role of Research and Education in Shifting Agricultural Productivity."

Previous cross-sectional studies are suspect because of intercorrelation between education and ability and the pervasiveness of research results. Historical analysis indicates that, for most of the last century, the educational level may have exceeded the level required for maximum efficiency. The role of research is indeterminate. *ERS-USDA.*

R. G. F. Spitze and J. D. Shaffer, "Research Agenda Priorities for Public Price and Income Policy—A Task Force View."

Recent events suggest the urgent need to develop a research agenda that would provide the knowledge base for an effective and consistent future national policy dealing with price and income problems related to agriculture and food. This paper suggests a conceptual framework for such research input and reflects initial discussions from a workshop that addressed this task. *University of Illinois and Michigan State University.*

GROUP XI—AGRICULTURE AND THE ENERGY CRISIS

Chairman: Ralph G. Kline, Virginia Polytechnic Institute and State University

J. H. Duloy, P. B. R. Hazell, and R. D. Norton, "Agriculture and the Energy Crisis: A Case Study in Mexico."

A general equilibrium model of Mexican agriculture is solved to evaluate the impacts on the sector of higher costs of agrochemicals and machinery operations and higher world market prices. It is found that agricultural production declines and aggregate sector incomes increase, but that the sector income distribution becomes more skewed and consumer welfare declines. *Development Research Center of the World Bank.*

David Mulkey and J. C. Hite, "An Input-Output Analysis of Energy Use by South Carolina Agriculture."

This study uses a 56 sector Leontief input-output matrix combined with a matrix of petroleum usage coefficients to estimate employment, tax revenues, and income for each economic sector in the state's economy. Based on these estimates, this paper examines the agricultural sectors of the South Carolina economy with an eye to their relative importance as contributors to state output, their relative ranking within the economy as to efficiency of fuel use, and the interindustry linkages between the agricultural sectors and other economic sectors in requirements for petroleum products. *Clemson University.*

J. B. Penn, Bruce McCarl, Otto Doering III, and Lars Brink, "Structural Input-Output Modeling of the Food and Fiber System Under Conditions of Fuel Scarcity."

Recent fuel shortages and attendant price increases have created an awareness of the pervasive dependence of our society and its economic system on energy. The crisis has prompted a new interest in a basic assessment of the relationship of the economy to all aspects of energy. This paper discusses types of issues currently being studied and describes a model utilized for energy related research. *Purdue University.*

Bruce A. McCarl, Kurt Klein, and Robert Peart, "The Effects of Energy Shortages on Grain Elevator Operations."

This study examines the sensitivity of country grain elevators to energy shortages. Supplemental explanatory variables include harvest days, elevator size, elevator location, and whether the elevator uses dry aeration. Elevators are seen to be sensitive to energy allocation with favorable effects found with respect to harvest days and dry aeration. *Purdue University.*

Otto C. Doering III, "Examining Changes in LP-Gas Availability for Agriculture in the Corn Belt."

This paper examines marketing and usage patterns for LP-gas in the context of its availability to Corn Belt Agriculture. An examination is made of household response to recent LP-gas price increases and conservation pleas. LP-gas availability for agriculture is placed in the context of competition with the household sector. *Purdue University.*

GROUP XII—MANPOWER POLICY

Chairman: Conrad Fritsch, Texas A&M University

Wallace Huffman, "A Cross-Sectional Analysis of Off-Farm Work of Wives of Farm Operators."

A summary of attempts to explain the supply of off-farm work of wives of farm operators is presented. Results from fitting the empirical specification of the off-farm work equation to Iowa, North Carolina, and Oklahoma county aggregate data suggest that the wives' rate and education, number of small children and adults in household, and closeness to jobs are significant explanatory variables. *Oklahoma State University.*

Marlys Knutson and Dean F. Schreiner, "Factors Affecting Work Time Supplied by Women Age 30 to 44 Years."

The female work force increased 320 percent between 1940 and 1970, as evidenced in both urban and rural areas. This study analyzes the time a woman is willing to supply in the labor market and factors influencing that supply—wage rate, residence, education, family income, and others. Results indicate that the wage in SMSA-nonfarm areas must exceed that in nonSMSA-nonfarm areas by $.85 for women to work an equal number of hours. *Environmental Protection Agency and Oklahoma State University.*

Robert O. Coppedge and Richard S. Johnston, "The Importance of Formal and Informal Education Effects on Labor Incomes of Rural and Urban Residents."

The primary objective of this study was to discern the effects of formal and informal education upon labor incomes. Both types of education exhibited effects on income. Urban-rural distinctions, all other things equal, were not significant in explaining the relationship between informal education and labor incomes. A difference by residence was noted for formal education effects. *University of Florida and Oregon State University.*

Donald D. Osburn, K. C. Sneeberger, and N. O. Miontz, "A Comparative Analysis of Costs and Benefits Associated with Graduates of Rural and Urban Post-Secondary Vocational Education Schools."

The cost of providing post-secondary vocational training in Kansas area vocational schools was about $900 for public expenditures; adding out-of-pocket expenditures and foregone earnings provided a total cost figure of about $5,000. The educational investment provided an added annual salary benefit of about $850. Applying investment techniques to the added costs and benefits resulted in internal rates of return in excess of 15 percent. A comparison of Missouri two-year vocational programs and Kansas one-year programs suggests diminishing returns associated with the added year of vocational training. The estimated internal rate of return was about 9 percent. *University of Missouri and Kansas State Teachers College.*

Wesley N. Musser, "Manpower Policy and Rural Development: The Potential of the Comprehensive Employment and Training Act."

The potential of the Comprehensive Employment and Training Act of 1973 to increase the effectiveness of rural manpower policy for rural development is considered. Program authority for allocation of funds and applicability of program content and structure for rural people is contrasted with previous legislation. *University of Georgia.*

James R. Simpson, "Open Access Job Fishing on the Sea of Graduate Studies: A Short Story about an Emerging Commonality Problem."

The heavy demand for agricultural economists through the 1960s is apparently over, causing concern among both academic economists and their administrators. The changing employment conditions indicate that graduate training of agricultural economists may be analyzed within the theoretical framework used in common property situations. The argument for the reasoning is effected by use of allegory. *American Embassy/Chile.*

GROUP XIII—FARM MANAGEMENT

Chairman: William D. Toussaint, North Carolina State University

V. James Rhodes, "A Survey of Large-Scale Hog Production."

This paper reports marketings, farrowings, growth, and other characteristics of 141 operations exceeding 4,000 head marketings found in a 1974 national survey. Feeding operations of more than 10,000 head were much more common than farrowing operations of that size. Growth of survivors has been vigorous, and continued growth is projected. *University of Missouri.*

Richard K. Perrin, "The Value of Information and the Value of Theoretical Models in Crop Response Research."

The concepts of the value of information and the value of a theoretical model are developed and applied to corn response research in Brazil. Soil test information was worth as much as $30 per hectare, the theoretical model employed was worth up to $23 per hectare, but two soil classification models had negative values. *North Carolina State University.*

John Holt, "Meaningful Farm Management Work—A View."

Money, time, knowledge of the "real world" situation, research rewards, writing style, and professional segregation all hinder effective farm management work. Salutary research areas might be risk and uncertainty, leasing arrangements, expansion, technological innovations, and model improvement. Current models should be improved or discarded by working on current real-world problems. *University of Florida.*

Joseph C. Meisner and V. James Rhodes, "Feedlot Economies of Size Revisited."

Structural shifts in cattle feeding have led to studies of possible production economies of feedlot size. While definite economies are suggested, recent patterns in cattle feeding firms suggest further considerations. New forms of attracting equity capital have led to multi-lot cattle feeding firms. *University of Missouri.*

Howard R. Thomas and William G. Brown, "A Proposed Land Quality Variable for Inclusion in Aggregate Production Function Analysis."

An index of productivity was determined for climatic regions of Southern Idaho. This index was used to derive an index of productivity for counties in Southern Idaho. The county index can be used in conjunction with published secondary data to account for land quality variation in county value production functions. *ERS-USDA and Oregon State University.*

GROUP XIV—INVESTMENT ANALYSIS

Chairman: Dan Bromley, U. S. Agency for International Development

Anthony M. Chisholm, "Taxes and Investment Decisions: The Appreciating Asset Case."

The economic effects of alternative methods of taxing the income derived from forestry are analyzed using a differential tax incidence model. Compared with a "neutral" income tax, I conclude that other forms of forestry taxation influence the choice of the optimal rotation period, land (site) values, and timber prices. *Australian National University and the University of California-Davis.*

Robert J. Kalter, Thomas H. Stevens, and Oren A. Bloom, "The Economics of Accelerated Outer Continental Shelf Leasing."

An analytical economic-engineering framework of the Outer Continental Shelf lands petroleum investment and production decision process is developed and utilized to evaluate public resource leasing policy alternatives. The impacts of alternative lease systems upon rates of production, investment levels, total resource recovery, and government revenue are presented and discussed. *Cornell University.*

Thomas A. Grigalunas, "Investment, Production and Returns to Potential Petroleum Development on the Outer Continental Shelf."

This paper describes an attempt to construct a detailed micro simulation of the economic aspects of potential offshore production of petroleum. Some example results for hypothetical offshore oil fields are presented, and a number of the policy uses which can be addressed with the model are discussed. *University of Rhode Island.*

John G. McNeely, "The Potential for Land Use Planning in Texas."

Present and potential land use problems in Texas include a coastal zone with shallow bays, marshes and grassflats high in biological activity, rapidly expanding metropolitan areas, major mineral production, and expanding industrial activities. Increasingly local and state pressures for continued economic growth are subject to national legislation emphasizing environmental constraints. *Texas A&M University.*

GROUP XV—FINANCIAL ANALYSIS AND VALUATION

Chairman: Warren Lee, Ohio State University

Ann An-Ning Chang, Fred C. White, and Wesley N. Musser, "Impact of Land Value Appreciation on Farm Expansion."

A general analytical framework for farm expansion was developed. Results show that the optimal financial strategy depends on land value appreciation. Although many farmers may prefer a relatively safe or high equity-asset position, a highly leveraged farm can expand significantly faster in periods of rapid land value appreciation. *University of Georgia.*

Donald G. Chafin, "A Technique for Taxation Assessment of Farm Real Estate Based Upon the Capitalized Income Stream of Agricultural Production."

The Ohio Legislature recently passed enabling legislation which allows real estate valuation for taxation purposes to be determined by agricultural productivity. The procedure for calculating agricultural value is outlined in the paper. The basic premise is that net income attributable to the land resource can be capitalized into economic value ratings according to type and land capability class of the soil. *The Northern Trust Company.*

Richard Simunek, "Capital Accounting in the Farming Sector Using National Economic Accounting Concepts."

A capital flows account is presented to measure net investment in the farming sector and to measure the direct effect of farm income on the balance sheet of the farming sector. Opening and closing balance sheets are linked by asset revaluations and the entries in the capital flows account, and, except for real estate transferred, all entries in the capital flows account are economic activities registered in the total net farm income accounts. *ERS-USDA.*

Donald R. Davidson, "Funds Flow Analysis of Nation's Major Dairy Cooperatives."

Utilizing the sources and uses of funds method of analysis, this study develops a financial profile of major dairy cooperative. By identifying and measuring all financial resources, it delineates factors responsible for generating working capital inflows and outflows. Significance of activities by-passing working capital are also revealed. Factors causing changes in assets and equities are indicated. *Farmer Cooperative Service.*

D. A. Lins, J. B. Penson, Jr., and C. B. Baker, "Simulating Farm Sector Outcomes under Varying Financial Market Conditions."

A simulation model that accounts for linkages between financial markets and the farm sector is used to examine the impact on farm financial structure of alternative interest rates. Solution values suggest that interest rates have a substantial impact on asset and debt structure as well as total cash flows. *ERS-USDA and University of Illinois.*

GROUP XVI—RURAL DEVELOPMENT: ISSUES OF STATE AND REGIONAL CONCERNS

Chairman: Herbert W. Grubb, Governor's Office, Texas

Charles L. Logsdon, Kenneth L. Casavant, and Wayne Thomas, "Boom or Bust Economy—Past History for Alaska?"

Ninety percent of Alaskan trade presently goes through Washington. Future trade channel needs depend on extent of Alaskan growth. An inventory of the Alaskan resource base is combined with a historical "boom or bust" phenomenon in Alaska to examine "bust retardant" capabilities of governmental policies. Research needs are identified. *Washington State University.*

Donald W. Lybecker, "Factors Affecting the Decline of Southern Illinois Towns."

Population changes in 21 counties of Southern Illinois were analyzed using regression analysis. The focus of the study centered on variables helpful in explaining the decline of communities. Distance of towns of one, five, ten, and twenty thousand population; miles to interstate; median county income; and county seat towns were significant. *University of Southern Illinois-Carbondale.*

Bruce A. Weber, "Trickling Down? The Responsiveness of Rural Poor Family Income to Regional Economic Growth."

Among white, nonaged, nondisabled rural Wisconsin families, the farm poor and rural nonfarm (RNF) nonpoor do not get their proportional share of additional regional growth. Although the RNF poor and farm nonpoor respond somewhat to growth, additional regional growth appears to widen the income gap between urban and rural families. *University of Wisconsin.*

Robert L. Oehrtman, Gerald A. Doeksen, and Dan Childs, "Factors Affecting Plant Location by Type of Industry and Community Size in Oklahoma."

This study uses multiple regression to analyze the change in employment in different size communities and by specific industry SIC codes. Employment change in different size communities was generally best explained by equations containing industry SIC codes. Employment change in specific industry SIC codes was generally best explained by equations containing community size variables. *Oklahoma State University.*

Paul H. Gessaman and Maurice Baker, "An Evaluation of Alternatives for Land Use Planning."

Alternatives for land use planning are examined. Impacts of alternative level on constraints on land use are discussed. Present planning models and two public administration models are related to land use planning needs. The public and private goods attributes of land are examined. Land use planning under the public choice model is discussed. *University of Nebraska.*

GROUP XVII—INTERNATIONAL TRADE AND FOREIGN DEVELOPMENT

Chairman: Merton B. Badenhop, University of Tennessee

Lia Vellianitis, "The Impact of Devaluation on U. S. Agriculture Exports."

A cross-sectional analysis using ordinary least square regression indicates that the impact of recent devaluation on U. S. agricultural exports was insignificant. A second analysis using time-series data indicates that, historically, exchange rate changes in other countries have had no impact on U. S. agricultural trade. *ERS-USDA.*

Robert L. Thompson and G. Edward Schuh, "Trade Policy and Exports: The Case of Corn in Brazil."

A partial equilibrium framework is presented to evaluate the social cost of exchange rate overvaluation and other restrictive export policies. The effect of Brazil's export policy on corn exports in the postwar period is analyzed. Rather substantial social costs were incurred, with accompanying income transfers from producers to consumers. *Purdue University.*

Ray W. Nightingale, "Emerging Agricultural Trade Patterns Among Arab Countries."

Agricultural commerce among disparate national political economies cannot be understood or predicted by conventional regional economic analysis. This study employs relative market share indexing to ascertain comparative trade advantage and reveal market dominance in an evaluation of the effect of one model of Arab economic integration on national agricultural sectors. *American University, Beirut.*

Susan D. Tripp, "Additional Evidence of Country Size and World Trade: A Time Series Analysis of Cross-Sectional Data—Provisional Estimates."

This study analyzes by cross-sectional data over time, 1958–1971, import demand patterns for 21 developed countries. By graphic analysis, regressions, analysis of covariance, and joint generalized least squares, new evidence is presented that better estimates import demand patterns and describes the economic traits of three subsets of countries within the large set of developed countries. *ERS-USDA.*

Robert L. Tontz, "Have U. S. Agricultural Exports Reached a Higher Plateau?"

The phenomenal increase in value of U. S. agricultural exports to an all-time high in 1973 is without precedent. This paper provides a perspective of the factors affecting the rise in exports, future developments needing study, and their relationship to a higher farm export plateau. *ERS-USDA.*

GROUP XVIII—METHODOLOGY

Chairman: Tim Mount, Cornell University

K. W. Lee and Lowell D. Hill, "Statistical Techniques for Estimating Relationships in Which the Dependent Variable is Dichotomous."

Researchers in the social sciences often encounter the methodizec problems that arise when the dependent variable in the relationship is dichotomous. Several statistical techniques for estimating such relationships are available including the conditional probability model, probit model, logit model, and discriminant analysis. This paper will compare these methods and suggest criteria for selecting among the alternatives. A comparison of the estimated function obtained by each technique will be made using a set of empirical data relating to purchase of a grain dryer. *University of Illinois.*

Yao-chi Lu, "A Production Function Approach to Measuring Productivity Growth in U. S. Agriculture."

This paper presents measurement of productivity change in U. S. agriculture. A general form of production function was fitted to the data. By testing the significance of the estimated parameters, the Cobb-Douglas function was selected. The productivity index was calculated from the time effects of the analysis of covariance model. *ERS-USDA, Oklahoma State University.*

William M. Holroyd, "Non-Probabilistic Aggregation or Probabilistic Sampling in Large-Scale Plant Location Problems?"

Prohibitively large-scale data requirements of a plant location problem force the researcher to choose between (1) non-probabilistic grouping methods or (2) probabilistic sampling methods. Choosing the former requires faith that unmeasured aggregation bias is minimized by virtue of logical justification. The latter methods allow measurement of probable bias. *Farmer Cooperative Service, USDA.*

Carolina King Kau, Edward H. Robb, and John P. Doll, "Estimating Agricultural Investment Functions for a State—Problems, Procedures, and Findings."

The determinants of plant and equipment investment for Missouri agriculture were explored. Capital stock and investment data were estimated from aggregate data available from USDA sources. A regression analysis based on time series data for the period 1950–1972 suggested that farm size, farm income, and capital stock are the major determinants of plant and equipment investment. *Alcorn State University and University of Missouri.*

Gerald Schluter, "Combining Input-Output and Regression Analysis in Projection Models: An Application to Agriculture."

The grafting onto a I/O based projection model of an adjustment equation to account for structural changes in the economy is examined and found to result in a relatively sensitive estimator of both the level of and changes in gross farm product. *ERS-USDA.*

GROUP XIX—METHODOLOGY AND MEASUREMENT IN MARKETING RESEARCH

Chairman: Lester V. Manderscheid, Michigan State University

Thomas L. Sporleder, "Relative Entropy as a Measure of Metropolitan Market Concentration in Food Retailing."

Relative entropy measures may be utilized as market rather than aggregate concentration measures, which presume no correspondence between the industry and markets. Since there are important structural categories of retail outlets within the food retailing industry, relative entropy measures applied to these categories for individual metropolitan markets offer a more refined quantification of concentration propensities than other, more traditional, concentration measures. *Texas A&M University.*

William J. Vastine and Thomas L. Sporleder, "Consumer Evaluation of Meat Identification."

National Livestock and Meat Board announced a voluntary meat identity standards program for meat retailers in September 1973. Consumer response to label information changes and their use of such information is critical to the program's success. The impact of the program was reflected by consumer awareness of label information changes. *Texas A&M University.*

Stanley R. Thompson, "Sales Response to Generic Promotion Efforts: A Case of Fluid Milk Advertising."

An evaluation of the effectiveness of generic promotion policy is critically dependent *inter alia* upon the selection of the analytical model. In comparison to the geometric distributed lag model, the polynomial lag formulation is shown to be more flexible and considered to provide a closer approximation of the true lag structure. *Cornell University.*

Mohamed Abdel-Ghany and Gordon E. Bivens, "Expenditures for Food Away from Home."

Expenditures for food away from home (E_{fah}) are examined, controlling for income, in relation to total consumption expenditures and family size, using 1960–61 Consumer Expenditure Survey data. Additionally, the influence of number of full-time earners, social position, family composition, region, and race upon E_{fah} are explored through multiple regression analysis. *University of Missouri-Columbia.*

Abdullah A. Saleh and Joseph Havlicek, "Urban Food Consumption Patterns and Their Associated Solid Wastes."

Despite the fact that residential solid waste loads result from consumption activities, little has been done to explain linkages between waste generation and consumption behavior. This paper explores such linkages with regard to food consumption activities, in the light of modern consumption theory. A four-equation model which describes household consumption-expenditure patterns and their associated solid waste is estimated and analyzed. *Purdue University and Virginia Polytechnic Institute and State University.*

GROUP XX—RURAL BANKING AND FARM DEBT

Chairman: Carl G. Anderson, Federal Reserve Bank, Dallas

William McD. Herr, "Factors Affecting Annual Changes in Non-Real Estate Farm Debt."

A single equation model for explaining annual changes in non-real estate farm debt held by major institutional lenders is presented. Gross cash outlays, internal funds, the labor-capital price ratio, and the interest rate was used to explain changes in outstanding non-real estate debt held by commercial banks, PCAs, and the FHA. Debt held by commercial banks was found to be responsive to changes in the relative cost of loan funds. *Farm Credit Administration and Southern Illinois University.*

J. Bruce Hottel, Robert D. Reinsel, and William D. Crowley, "Debt Status of U. S. Farm Operators and Landlords by Economic Class, 1960, 1966, 1970."

Census surveys indicate that larger farms made greater use of debt, and repayment ability tended to explain the close relation of debt to economic size. However, debt also appeared important in explaining farm growth. The ratio of debt to equity was higher on larger units, and rented land was a greater component of assets utilized. Also, economic efficiency seemed greater on larger farms which provided substantial incentive to increasing size and consequently greater debt utilization. *ERS-USDA.*

Michael Boehlje, "A Model to Analyze the Use of Deposit and Non-Deposit Funds by Rural Commercial Banks."

With the rapid increase in farm firm capital requirements compared to deposit growth in rural areas, rural banks may be forced to use non-deposit sources of funds to maintain their market share and service the agriculture of the future. This paper presents an analytical model that can be utilized to determine the optimal use of deposit and non-deposit funds in the acquisition of loans and investments and summarizes the results of applying this model to a rural commercial bank. *Iowa State University.*

Wayne A. Hayenga, "Rural Bank Ownership Changes: Possible Effects on Agriculture and Rural Communities."

Results of recent studies on the effects of changing bank ownership structure will be reviewed. These results will then be extended to consider the implications on agriculture and rural communities. A critique of past research methods and a summary of research problems confronted will be discussed. *Texas A&M University.*

Peter J. Barry and Gregory J. Greathouse, "Country Bank Management of Yield, Risk, and Liquidity on Agricultural Loans."

This paper identifies and measures the extent of actions taken by country banks to modify yield, risk, and liquidity of agricultural loans and indicates that such actions differ notably among size, and to a lesser extent, type of bank. *Texas A&M University.*

GROUP XXI—POLICY FORMATION AND IMPLEMENTATION: ITS EFFECT ON AGRICULTURE AND ENERGY PRODUCTION

Chairman: John G. Stovall, ERS-USDA

Allen Grommet, "Enactment of the Food and Consumer Protection Act of 1973: A Case Study in Agricultural Policy Formation in an Urban-Industrial Society."

Passage of the 1973 farm bill highlights the changing picture of agricultural politics. Support from non-farm interests was essential. Watergate and executive branch leadership problems gave Congress unwelcomed latitude to write a true Congressional farm bill. Despite the problems, farm policy decisions are finding resolution in higher echelons of government decision-makers. *Michigan State.*

R. C. Kite and R. C. Haidacher, "A Planning-Decision Model for Surplus Commodity Removal Programs: Application to Fiscal 1973 Purchases."

A deterministic simulation system is used to develop alternative commodity purchase plans for a surplus commodity removal program and to show their differential impacts in terms of costs, trade-offs, and benefits. The operation of the model is illustrated by an analysis based on Section 32 puchases in fiscal 1973. *ERS-USDA.*

Stephen F. Matthews and V. James Rhodes, "Agriculture and Limited Partnerships."

Limited partnership "funds" have increasingly been utilized to attract capital into agricultural businesses as cattle feeding, egg production, and citrus groves. Both limited partners and general partners derive advantages and disadvantages from the organizational entity, though not necessarily the same ones. Tax reform, however, is a common threat to both groups. *University of Missouri-Columbia.*

Michael J. Phillips, "Cooperative Marketing Strategies in the 1970s."

As agriculture becomes more industrialized, closer coordination of farm production with the processing, marketing, and distribution functions is essential. The question remains as to how the system will be coordinated and who will control it? This paper analyzes various marketing strategies farmers have available through their cooperatives in coordinating and controlling the system. *Farmers Cooperative Service, USDA.*

O. William Asplund, "The Rise and Fall of Margarine Taxes and Regulations."

The paper looks at the regulations and taxes applied to margarine over the years by the federal government and by a typical state government. Both excise taxes and restrictions on color proved to be effective in curbing margarine consumption. The paper also suggests that margarine is no longer the inferior good it was once thought to be. *Utah State University.*

GROUP XXII—WASTE MANAGEMENT

Chairman: H. A. Henderson, Tennessee Valley Authority

G. L. Horner and Ralph B. Hwang, "Water Quality Goals and the Economics of Agricultural Production."

The expected policies of the Environmental Protection Agency will restrict the pollution that originates from agricultural production to achieve the 1983 water quality goals. An analytical model is presented showing the effects on water quality from agriculture and evaluating the economic impacts of alternative policies designed to achieve the standards. *ERS-USDA and University of California.*

C. Edwin Young and Gerald A. Carlson, "The Demand for Land Treatment of Municipal Wastewater."

A demand curve for land treatment of municipal wastewater is derived from a loss minimization framework. The underlying production framework assumes the production of three outputs: a flow of wastes, a level of treatment, and a salable by-product. As the opportunity cost of by-product production rises, the adoption of land treatment will rise. *North Carolina State University.*

Bruce W. Cone, "An Estimate of Point Demand for Sludge."

The hypothesis tested in the research reported here was that the price of sludge need not be negative. A traditional application of demand theory was used. The value of municipal sewage sludge will range from some negative price to $513 per 100,000 gallons f.o.b. the treatment facility. *Pacific Northwest Laboratories.*

Eugene Johnson and John E. Waldrop, "An Approach for Estimating the Costs Associated with Detoxifying Pesticide Containers."

Pesticide users are confronted with the problem of disposing of pesticide containers. A conceptual model for estimating the cost of detoxifying containers is presented. A hypothetical detoxification system is outlined. Data requirements and techniques for estimating costs are considered. Finally, the incidence of costs and policy issues are discussed. *Mississippi State University.*

Joseph Havlicek, Jr., and Abdullah A. Saleh, "Quantity, Composition and Seasonality of Residential Solid Waste."

Information which explains the rising level and changing composition of residential solid waste is scarce if not lacking. This paper presents the results of a quantity and composition analysis of household solid waste and attempts to define their relevant patterns as influenced by household social, economic, and technological characteristics. The seasonal distribution of total residential solid waste is also analyzed. *Virginia Polytechnic Institute and State University and Purdue University.*

GROUP XXIII—MEASUREMENT TECHNIQUES FOR RESOURCE PLANNING

Chairman: Earl Swanson, University of Illinois

Dilip Pendse and J. B. Wyckoff, "Water Reservoir, Natural Beauty and Public Policy: A Case Study."

This paper reports an application of a methodology to estimate dollar worth of landscape and riverscape with and without the reservoir. The study objective was to ascertain trade-off values for five environmental features relevant to Santiam Valley, Oregon: safety from floods, water recreation scenic beauty, wilderness, and historical site. *Virginia Polytechnic Institute and State University and Oregon State University.*

Raleigh Barlow and Raymond D. Vlasin, "Indicators of Environmental Quality in the Use of Land Resources."

Provisions are made in the National Environmental Protection Act for the development of environmental indicators. Indifferent success has been realized in developing indicators for land. Needed measures and a suggested land budget approach are discussed as possible means for securing meaningful indicators of environmental quality with land use. *Michigan State University.*

C.W.J.M. Corssmit, "Regional Reductions in the Value Added Due to Flooding in the Portland Reach of the Willamette River in Oregon."

Economic losses caused through unemployment of regional resources in the Portland, Oregon, reach of the Willamette River were approximated by estimating reductions in value added by industry. Estimates were obtained using secondary data such as I/O tables, employment statistics, hydrologic maps, location directories, and price indices. *Cornell, Howland, Hayes and Merryfield, Bellevue, Washington.*

Alan Randall, "Quantifying the Unquantifiable: Benefits From Abatement of Aesthetic Environmental Damage."

Abatement of aesthetic damage to the macroenvironment is a non-market public good; its valuation presents theoretical and practical difficulties. Alternative techniques of quantifying the benefits of environmental improvements are discussed and evaluated. A case study, using aggregate bid methodology and bidding game techniques, is presented. Bidding game techniques are cautiously endorsed. *University of Kentucky.*

Robert R. Lansford, Shaul Ben-David, Thomas G. Gebhard, Willem Brutseart, and Bobby J. Creel, "Evaluation of Population Growth and Per Capita Consumption of Water on the Regional Economic Growth in the Rio Grande Region in New Meixco."

A socioeconomic model was used to estimate the effects of alternative population projections and domestic per capita consumption estimates on distribution of production and water requirements between 1970–2020. Results indicate there are sufficient water resources in the region to carry on a viable economy under all four alternatives. *New Mexico State University, University of New Mexico, New Mexico State University, New Mexico Institute of Mining and Technology, and New Mexico State University.*

GROUP XXIV—MARINE ECONOMICS AND SEAFOOD

Chairman: Kenneth J. Roberts, South Carolina Marine Resources Center

E. Evan Brown, "World Mariculture and Aquaculture."

Mariculture and aquaculture are rapidly expanding areas of food production. Worldwide information is presented, followed by detailed information for Japan and the United States. Cultured supplies of fish are expensive compared to the wild catch in spite of feed conversions superior to beef, hogs, and broilers. *University of Georgia.*

W. E. Johnston and P. G. Allen, "Technology Assessment and the Direction of Future Research: Use of Computerized Budgeting for Lobster Aquaculture."

In multidisciplinary research endeavors, objectives may be clearly defined but central evaluation lacking. Additionally, where models cannot be well specified, simulation techniques are unusable. For research directed towards commercial lobster aquaculture, the application of computerized budgeting in evaluating the state-of-the-arts and in assessing alternative research strategies is illustrated. *University of California, Davis.*

J. John Carbonneau and Richard J. Marasco, "The Clean Water Act and Its Probable Effects on Interregional Competition: The Oyster Industry."

The Clean Water Act's goal is zero effluents into navigable waterways by 1985. The problem to be investigated is the interregional impact associated with changes in the cost of processing oysters. The empirical model of interregional competition used is an adaptation of the Takayama and Judge, and Lee and Seaver models. *University of Maryland, College Park.*

Donald F. Mulvihill and Leonard J. Konopa, "Physical Distribution of Fresh Coastal Fish Into the Midwest: An Evaluation of a Proposal to Establish a Computerized System."

This study examines the feasibility of a controlled physical distribution and communication system to enable Midwestern retailers to have an ensured supply of fresh coastal fish within 24 hours. The lack of intensive demand by buyers and the fragmentation of the fishing industry appear to nullify such a system. *Kent State University.*

GROUP XXV—EXTENSION PROGRAM DEVELOPMENT AND EVALUATION

Chairman: D. W. Parvin, Jr., Mississippi State University

Tom E. Prater, "Estate Planning—'A Fact in Extension Education.' "

A definite need for Extension education on estate planning in Texas is being met by development of versatile planning programs. Rapidly rising farm values, low liquidity positions, and tax laws will present estate owners with greater tax burdens in the future. Tax consequences can be reduced with adequate estate planning. *Texas A&M University.*

Hugh L. Liner and Fred D. Sobering, "Developing and Implementing an In-Service Education Program in Economics for County Extension Personnel."

The report is a description of the development and implementation of an extensive in-service training program in economics for county personnel in North Carolina. A study committee's training proposal, its acceptance by the department and administration and county personnel is dicussed as well as outlines for four training sessions. *North Carolina State University.*

Wallace Barr and Harold Guither, "Suggestions for Regional Extension Program Development."

The North Central Regional Extension Public Policy Committee has been able to conduct successfully a number of multi-state extension policy issues over a number of years. The experiences suggest that success begets success and performance is repeatable. The organizational guidelines and procedures enumerated are designed to improve regional cooperation. *Ohio State University and University of Illinois.*

William S. Farris, "How Cooperatives Communicate with Members."

The cooperative uses many avenues to communicate, to report, to build understanding, and to sell to or for its members. The successful cooperative will be well organized, serve real needs, develop good communications with its members, and maintain high quality management. *Purdue University.*

Garey B. Perkins, "Assessment of the Impacts of the Expanded Food and Nutrition Education Program on Nutrition Aides."

This paper assesses the impacts of USDA Extension Service's Expanded Food and Nutrition Education Program (EFNEP) on nutrition aides. Aides and their families achieved significantly greater benefits than did the program families with whom they worked. This indicates success in the program's secondary objective of providing benefits to aides. *Office of Planning & Evaluation, USDA.*

GROUP XXVI—IMPACT OF GOVERNMENT REGULATION ON AGRICULTURE

Chairman: J. Edwin Faris, Washington State University

Boyd M. Buxton and Richard Fallert, "Impact of Dairy Product Imports on U. S. Milk Price."

A static partial equilibrium model is developed to evaluate the short-run impact of dairy product imports on U. S. milk prices. Results showed that importing an additional 500 million pounds of milk equivalent in dairy products would reduce U. S. milk prices received by farmers an estimated 13 cents per cwt. *ERS-USDA.*

T. Mann and A. Paulsen, "The Economic Impact of Restricting Feed Additives in Livestock and Poultry Production."

Society is continually faced with the decision of the trade-off between environmental risks and economic costs. The use of certain antibiotics and DES in livestock and poultry production has produced unacceptable environmental risks. The objective of this study was to determine the economic impact from banning the use of these two pieces of technology in beef, pork, broiler, and turkey production. *Iowa State University.*

Dennis U. Fisher, "An Analysis of Agricultural Workmen's Compensation Insurance Rate Differentials—Oregon Compared to Other States."

Oregon employers pay higher workmen's compensation insurance rates than employers in most other states. This study revealed that the higher rates were due to the statutes pertaining to determination of permanent partial and permanent total disability claims, and interpretation of those statutes by the Workmen's Compensation Board and the Oregon court system. *Cornell University.*

Rafael Samper and Edna T. Loehman, "Measuring the Benefits of Drinking Water Programs."

Regression analysis is used to explain how changes in the quality of drinking water affect the rate of reported incidence of infectious diseases. Rate equations are developed for infectious hepatitis and shigellosis, and their use is illustrated by estimating, for 1970, the changes in reported U. S. cases of these diseases through changes in drinking water quality. *University of Florida.*

J. Richard Conner and Vernon C. McKee, "Florida's System for Resource Allocation in Agricultural Research."

The attention of economists to governmental spending has led to the development and ever increasing use of Planning, Programming, Budgeting Systems (PPBS) in Federal and State governments and educational institutions. The Institute of Food and Agricultural Sciences (IFAS) at the University of Florida has been implementing PPBS since 1969. Through the use of a well-designed program classification structure, IFAS has achieved improvements in its resource allocation process, particularly for its research programs. The use of PPBS in the development and use of quantitative measures of efficiency, effectiveness, and benefits of resource allocations to research is illustrated. *University of Florida.*

GROUP XXVII—ECONOMICS OF PESTICIDE USE

Chairman: Ronald D. Lacewell, Texas A&M University

Gerald A. Carlson and Donald V. DeBord, "Demand for and Cost of Mosquito Abatement."

Mosquito abatement leads to externalities associated with draining coastal marshes and the use of pesticides. It produces a product which is collectively consumed. This paper presents a simultaneous equation model and estimates for 30 districts over 15 years of the demand for public pest management. *North Carolina State University and National Cotton Council.*

Arnold L. Aspelin, "A Framework for Evaluating Risks, Costs, and Benefits of Pesticide Use in Support of Pesticides Regulatory Decisions."

This paper presents a framework for comprehensive multi-disciplinary analysis of the risks, cost, and benefits of pesticide uses in support of pesticide regulatory programs. It also discusses the relationship of such analyses to EPA's pesticide regulatory program being implemented under the Federal Pesticide Law, as amended substantively in 1972. *Office of Pesticide Programs, Environmental Protection Agency.*

Robert N. Shulstad, "Measuring a Social Cost of Environmental Pollutants Through the Use of An Information Variable."

Avoidance costs of pollutants are estimated by introducing an information variable into the recreationist's demand model, hypothesizing a discontinuance or decrease in their activity as information concerning contamination is received. The decrease in recreationists' consumer's surplus estimates a social cost of environmental pollutants. Mercury and Oregon's pheasant hunters are examined. *University of Arkansas.*

Darrel L. Hueth, "Some Preliminary Results Concerning the Influence of Increasing Pest Resistance to Malathion on the Optimal Management of the Cereal Leaf Beetle."

This paper presents some preliminary empirical results and consequent policy implications from an application of an interseasonal pest management model to the cereal leaf beetle. The results of the study reflect the development of pest resistance to the insecticide most widely used for control purposes. *University of Rhode Island.*

GROUP XXVIII—COMPUTER APPLICATION IN EXTENSION AND INSTRUCTION PROGRAMS

Chairman: Buel Lanpher, Extension Service, USDA

Harlan Hughes, Roy Black, and Allen Wollensien, "Computerized Management Aids in Agricultural Extension Programs—How Effective are They?"

Computerized Management Aids (CMA's) are described in terms of how many runs were made, for what purpose, and what is the direct cost of using CMA's in Extension Educational programs. An attempt is made to evaluate the benefits Extension Agents and farmers received from using CMA's. *University of Wisconsin and Wisconsin Extension Service, and Michigan State University.*

Bill Brant and D. Kletke, "Effective Farm Management Decisions Using Computers."

A workable system of personalized farm management using computer assisted techniques is presented. Discussed are base data preparation using the budget generator, personalization of base data and other user provided data, the optimizing algorithm (LP-Farm), and output readability and usability. It is both an extension and a professional farm management system. *Oklahoma State University.*

Darrell L. Gerke and Gerald A. Harrison, "A Computerized Data Management Tool for Analysis of Soybean Storage Hedging Returns in Selected Areas of Indiana."

Elevator operators are avid users of the futures markets to hedge stored grain because the extension education program has helped them understand hedging theory and mechanics. Farmers have been slow to adopt hedging, possibly because of lack of ability to understand basis changes. The objective of this study was to analyze storage hedges as a practical management tool for farmers. *Purdue University.*

David L. Debertin, Gerald A. Harrison, Robert J. Rades, and Larry P. Bohl, "A Micro-Simulation Approach to the Estimation of Returns to Learning and Information in Corn and Soybean Production."

A management game incorporating key decisions in corn and soybean production was constructed. Participants in an experiment were asked to play the game by making a series of decisions. Some of the participants in the experiment were denied access to research information and/or feedback from the previous decision. Results of the experiment indicated a significant positive return to both information and learning from feedback. *University of Kentucky and Purdue University.*

Edward L. McLean, "Simulation Games for Introductory Agricultural Economics and Rural Sociology Courses."

Simulation games are defined and analysis is directed to the appropriateness of such methods for university social science courses. A simulation game, developed by the author and utilized with a relatively wide range of participants, is described in detail. Recommendations are specified to guide the consideration and potential use of simulation games in introductory social science courses. *Clemson University.*

GROUP XXIX—PROBLEMS CONCERNING LOW INCOME CONSUMERS

Chairman: Leroy Davis, Southern University

Sylvia Lane, "Food Aid Program Impacts on Low Income Consumers."

Diets of participants in the Food Distribution Program and Food Stamp Program interviewed in this study appear to be nutritionally superior to those of comparable non-participating low-income households. Of the two programs the Food Stamp Program appears to result in a higher level of nutrition for larger numbers of people. *University of California, Davis.*

Ron Mittelhammer and Donald A. West, "Impact of the Food Stamp Program on the Demand for Food, Some Theoretical Considerations."

A theoretical framework is used to develop methods for analyzing the impact of a food stamp transfer versus cash transfer on low-income households' demand for food. Preliminary comparisons suggest that many households' demand will be unaffected by the form of the transfer, but many of those who would consume at levels below the USDA low-cost food plan with a cash transfer will demand more food under the stamp transfer. *Washington State University.*

J. Michael Gorham and Anthony A. Prato, "An Analysis of Nutritional Intake for Selected Families in Florida's Expanded Nutrition Program."

Levels and changes in nutrient intake over four consecutive food recalls (1970–72) are computed and their relationship to 13 socioeconomic characteristics estimated by least-squares regression for a sample of 168 ENP homemakers in two Florida counties. Results indicate that most family characteristics do not significantly affect the level or changes in nutrient intake. *University of Florida and Colorado State University.*

Jerry Foytik, "The Economy Diet."

Low-cost food plans offer little guidance to persons with limited food budgets. Diets costing much less can be determined by linear programming methods applied to specified nutritional standards and selected palatability requirements. The wide discrepancy between the cost levels needs examination and explanation. *University of California, Davis.*

Craig C. Wu and Abbas Mirakhor, "A Recursive Model of Consumption: The Case of Taiwan's Farm Families."

A recursive model is used to study the consumption behavior of Taiwan's farm families. Findings include: (1) the farm families are not overpopulated; (2) education is a significant contribution to savings; (3) there is no demonstration effect on consumption via education, but there is a significant demonstration effect via off-farm contact. *University of Alabama, Huntsville.*

GROUP XXX—QUANTITATIVE METHODS IN WATER RESOURCE PLANNING

Chairman: Leon Danielson, North Carolina State University

James W. McFarland, "Some Results Concerning Groundwater Management and Salinity Control in Northwest Mexico."

This paper presents a dynamic programming formulation for the conjunctive management of a groundwater aquifer and soil salinity. Some preliminary results are given for an application in an irrigation area in Northwest Mexico. *University of Rhode Island.*

Leonard L. Bull and John D. Sutton, "Incorporation of Environmental Indicators into River Basin Planning."

Multiple objective planning requires evaluating an expanded variety of impacts. Two USDA river basin studies will analyze the impacts of alternative "management strategies" on the "package of products" produced on units of cropland, pasture, and forest. Environmental indicators are incorporated into a linear programming technique for regional planning. *ERS-USDA, East Lansing, Michigan.*

B. Ted Kuntz, "Least Cost Linear Programming Analysis, an Application to Agriculture Related to Multiple Objective Planning and Evaluation in River Basin Studies."

The Water Resources Council has recently implemented multiple objective planning and evaluation in most on-going river basin studies. Least cost linear programming provides a technique for estimating the beneficial and adverse effects of proposed management/development plans on agriculture, and provides detailed data needed to complete the MOPE accounts for a plan. *USDA-ERS, Corvallis, Oregon.*

Reuben N. Weisz and John C. Day, "A Regional Planning Approach to the Floodplain Management Problem.'

The research report here deals with the problem of planning and use and engineering alternatives for floodplain management. A computer-based mathematical optimization approach is used to select the combination of management alternatives that will maximize the aggregate economic productivity of all land resources within a study area. *University of Arizona.*

John E. Keith and Jay C. Andersen, "Measuring Economic Surplus Changes Using Mathematical Programming Models: Utah Water Allocations."

Mathematical programming models of Utah water allocations were developed which produce VMP curves for agriculture and supply curves. These curves were altered, using various constraint changes, to conform to alternative water policies. Differences between the curves at efficient allocation levels were calculated as measures of producers and consumers surplus changes. *Utah Water Research Laboratory and Utah State University.*

FIRST AWARD PAPER IN THE UNDERGRADUATE STUDENT ESSAY CONTEST

Analysis of the Accuracy of USDA Hog Farrowings Statistics

JAMES M. THOMSON

FOX AND OTHERS [4, 7] report that government statistics and price forecasts exhibited numerous shortcomings during the volatile economic conditions of 1973. Fox suggests that substantial infusions of money and effort will be required to develop a forecasting system that will perform satisfactorily under current conditions. Undoubtedly changes in government statistics and forecasts are needed. However, such changes should be carefully made, else good statistics will be discarded along with the bad. Hopefully, careful evaluation of shortcomings and strengths of each statistical series will precede any changes in the series. This paper represents an effort at such an evaluation for the USDA hog farrowings intentions report figures. This series was selected for study since the price elasticity of demand for hogs is low and errors in these statistics could cause large, unexpected, and disruptive price changes. Other series, especially those for other commodities with low demand elasticities, also might be evaluated using similar techniques.

The quarterly 10-state farrowing intentions figures which were examined for accuracy in the study are released by the Statistical Reporting Service (SRS) in the *Hog and Pig Report* [10]. The initial report of farrowing intentions for a given quarter is issued by SRS about three months before the start of the quarter. Next, a revised report of quarterly farrowing intentions is issued early in the quarter to which it applies (referred to as first revision in study). Finally, in the next quarter SRS reports the actual number of sows that farmers did farrow during the quarter (referred to as second revision in study).

In the study the accuracy of farrowing reports from September 1959, when 10-state[1] quarterly forecasts began on a continuous basis, to March 1973 was examined. During this period the SRS used three separate types of surveys to make forecasts: Rural Carrier Route Survey (RCRS), Probability Mail Survey (PMS), and Multiple Frame Survey (MFS). Thus, the analysis made a general evaluation of the accuracy of the farrowing reports as well as a determination of whether the changes in survey techniques resulted in increased accuracy.

The Rural Carrier Route Survey (RCRS) covered the time period from September 1959 to March 1963. The survey included 10 states. The mailman was given survey cards to deliver on his route to farmers raising hogs. The farmer was asked to fill them out and return them by mail. The major survey took place every six months, June and December. In March and September a subsample of the farmers who replied in the previous survey was resampled.

The Probability Mail Survey (PMS) covered 10 states during the time period from March 1963 to March 1970. The sample of farmers was drawn from the state farm census or a list from the ASCS office.

The present survey, the Multiple Frame Survey (MFS), began in March 1970. The MFS is a combination of two surveys, the Probability Area Fram Survey and a List Frame Survey. The Probability Area Frame samples land segments throughout the country. This allows for a more complete coverage of all operators involved in hog raising. Since livestock can be highly concentrated, a list of large livestock producers (list frame) was created and is updated from sources independent of the Probability Area Frame (i.e., state farm census, ASCS list), to reduce the problem of sampling variability. The List Frame and Probability Area Frame are combined to form the Multiple Frame sample. The area frame is sampled bi-annually while the list frame is sampled quarterly [5].

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[1] The 10 states are Wisconsin, Illinois, Iowa, Minnesota, Indiana, Missouri, South Dakota, Nebraska, Kansas, and Ohio.

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Performance Test Employed

Accuracy of the sow farrowing forecasts was evaluated according to the following criteria:

1. A given farrowing forecast should improve upon the accuracy of information contained in previous forecasts that were developed on the basis of less information.
2. Farrowing forecasts should be free of systematic error or "bias."

For purposes of evaluating accuracy of sow farrowing intention figures, error was defined as the difference between the early farrowing forecasts and the final revised estimates which the USDA issues every four years. In cases where the final revised estimates were not available, the revised estimates issued one year after the quarter to which they apply were used as the measure of actual farrowings for determining error levels.

It should be noted that error arises from two sources in the initial and first revised farrowing reports. The first source is sampling and reporting error over which SRS has control. The second source is error caused by a change in farmers' intentions from those contained in an earlier report. It was not possible to determine how much of the error was due to each cause. The source of the error might be examined in subsequent research.

Theil's *R* Statistic

Theil's *R* statistic [9] was employed to examine the two revised sows farrowing forecasts for each quarter to determine whether these forecasts were more accurate than the immediately preceding ones. This ratio is written as

$$R = \frac{F_t - F_{t-1}}{A_t - F_{t-1}}$$

where

F_t = current forecast,
F_{t-1} = previous forecast,

and

A_t = actual production.

Values obtained for the *R* statistic identify various types of errors in the forecast. For a given comparison of F_t and F_{t-1}, the current forecast is nearer to actual production than the previous forecast when $0 < R < 2.0$. A perfect forecast would result in an *R* value of 1.0.

Comparisons in which $0 < R < 1.0$ and $1.0 < R < 2.0$ result when a current forecast F_t undercompensates or overcompensates respectively for the error in the previous forecast F_{t-1}. However when $0 < R < 2.0$, the undercompensation or overcompensation is sufficiently small that F_t is a more accurate predictor for the error in the previous estimate.

The first and second revisions of the farrowing intentions reports based on the Rural Carrier and Multiple Frame surveys generally were more accurate than earlier forecasts (see Table 1 values for $0 < R < 2.0$). However, only about 50 percent of the *R* statistics for the Probability Mail Survey were between 0 and 2. The PMS exhibited numerous turning point errors ($R < 0$).

The absolute forecasting error associated with succeeding revisions should be less than that for earlier forecasts to exhibit increasing accuracy. All the surveys displayed the property of decreasing absolute error (Table 2). [Also, surprisingly, the old RCRS was more accurate than either the RMS or MFS (Table 2).] While the forecasts showed low absolute error, forecasting errors which reach nearly 5 percent may create problems for farmers and marketing firms because of the low price elasticity of demand for hogs. This problem, however, may be diminishing, since the absolute forecasting error has been decreasing in the MFS.

Mean-Square Error Statistic

A test to determine absolute forecast accuracy and systematic error or bias was devised by Mincer and Zarnowitz [8]. This test takes as the goal of forecasting the minimization of the mean-square-error (*MSE*), that is, the average squared difference between the actual and the forecast values. The sample *MSE* is defined as

$$MSE = \sum \frac{(A_t - E_t)^2}{N}$$

where

A_t = actual values,
E_t = forecast values,

and

N = number of observations.

This *MSE* statistic measures the dispersion around the line of a perfect forecast (LPF) which can be conceived of as a 45-degree line through the origin. To obtain this statistic, a least squares line must be fitted to a scatter diagram of the actual realization (A_t) and estimates (E_t) where $A_t = \alpha + \beta E_t$.

Ideally, the entire regression line should coincide with LPF. The greater the divergence of the regression line from LPF, the larger the un-

Table 1. **Distribution of R statistic comparing accuracy of first revised and second revised hog farrowings report to accuracy of earlier reports, by survey, September 1959–March 1973**[a]

Forecast and Survey	Percentage of R Statistics				
	<0	0–1.0	1.01–2.00	>2.00	0–2.00
First Revision					
Rural Carrier[b]	21.4	64.2	14.2	0.0	78.4
Prob. Mail Survey[c]	35.7	35.7	14.3	14.2	50.0
Multiple Frame[d]	30.7	61.5	7.6	0.0	69.1
Second Revision					
Rural Carrier[b]	14.2	28.5	35.7	21.4	64.2
Prob. Mail Survey[c]	32.1	42.8	7.1	17.8	49.9
Multiple Frame[d]	23.0	61.5	7.6	7.6	69.1

[a] For December 1972 to March 1973 final revised estimates of farrowings based on census and other data were not available. Therefore, for this period revised farrowing estimates, published in *Hogs and Pigs* one year after the quarter to which they apply, were used as the measure of actual farrowings in computing the R statistics.

[b] Calculations made from figures for September 1959 to December 1962.

[c] Calculations made from figures for March 1963 to December 1969.

[d] Calculations made from figures for March 1970 to March 1973.

der or over prediction. The larger the deviation of the slope of the regression line from unity, the less efficient the forecast.

The sample *MSE* can be broken down as follows:

$$MSE = \sum \frac{(A_t - E_t)^2}{N}$$

$$= (\bar{A} - \bar{E})^2 + (1 - \beta)^2 S^2_e + (1 - R^2_{ae}) S^2_a$$

where

$\bar{A}$ = sample mean of actual values;
$\bar{E}$ = sample mean of forecast values,
S^2_a = actual sample variance,
S^2_e = forecast sample variance,
β = slope of the regression line,

and

R^2 = coefficient of determination.

The first component on the right, $(\bar{A} - \bar{E})^2$, may be termed the mean component (*MC*), the second the slope component (*SC*), and the third the residual component (*RC*). If the forecast is unbiased, $MC = 0$; if it is efficient, $SC = 0$. In forecasts which are both unbiased and efficient, *MC* and *SC* will disappear, and *MSE* will equal the residual variance (*RC*). *MC* and *SC* can be interpreted as that portion of the total error resulting from systematic error tendencies of the forecast system, while *RC* comprise the random error.

To determine whether the forecasts are unbiased and/or efficient, tests of statistical significance are required. The test that E is both unbiased and efficient is the test of the joint null hypothesis: $\alpha = 0$ and $\beta = 1$.[2] The test of efficiency is the test of the null hypothesis: $\beta = 1$.

Amount of Bias Detected by Mean-Square Error Statistic

The forecast mean bias statistic shows that statistics obtained via the MFS underestimated actual farrowings (underestimation is indicated by a positive sign preceding the figure; over-

Table 2. **Size of average absolute percentage error in USDA 10-state sow farrowing intentions reports by survey and report, September 1959–March 1973**[a]

Survey	Average Absolute Error (percent)		
	Quarterly Report I[b]	Quarterly Report II[c]	Quarterly Report III[d]
Rural Carrier	4.45	2.95	1.15
Probability Mail Survey	4.87	4.16	2.62
Multiple Frame	4.63	3.75	1.88

[a] Figures used for computing absolute error were the same as those used for computing R statistics in Table 1.

[b] Issued about three months before quarter to which it applies.

[c] Issued early in quarter to which it applies.

[d] Issued one quarter after quarter to which it applies.

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[2] The procedure used to test the null hypothesis can be found in [3, p. 64].

estimation by a negative sign). The opposite tendency was shown by the RCRS and PMS. The square-root *MSE* measure showed that estimating errors decreased with each new estimate. These results support the conclusion made from the Theil's *R* statistic. (See Table 3.)

In general the statistical test of the joint null hypothesis ($\alpha = 0$ and $\beta = 1$) for bias and inefficiency indicated that only the second forecast of the RCRS was significantly biased and inefficient. This forecast was also found to be inefficient when $\beta = 1$ was applied independently of $\alpha = 0$. This indicates that the main cause of low performance in forecasting was due to inefficiency rather than bias. All other forecasts considered were found to be significantly unbiased and efficient.

Detection of Systematic Error

Although the *MSE* statistic showed little systematic error, a plot of the standardized residuals showed a systematic error of underestimating when actual farrowings increased and overestimating when farrowings decreased. This conservative pattern in the estimates might have resulted from a bias created by the agricultural statisticians who set the estimates. The statistician makes a state estimate that is sent to the Crop Reporting Board in Washington, D.C. There, the estimate may be changed by the Board to insure that it is consistent with regional (i.e., 10-state estimate) or national estimates [11]. Since the statistician who sets the state estimate is aware of the above procedure, he might bias his report to coincide more closely with what he thinks Washington expects, rather than reporting what actually occurred in his state.

Summary and Implications

Subsequent revisions of the farrowing reports exhibited greater accuracy than earlier estimates. The PMS was a relatively poor survey in comparison with the other two as evidenced by its larger absolute forecasting error. There appeared to be no bias in the forecasts obtained by any of the surveys. However, there existed a small conservative pattern as discussed earlier. A recommendation can be made that may reduce the error in the farrowing intentions reports obtained through the Multiple Frame Survey. If state estimates were released from state offices, regional differences in production could be identified. Presently state estimates are sent to Washington for Board Call. At the board the estimate may be revised to conform with national estimates resulting in the obscuring of any regional differences in production. Releasing the estimate from the state's office may eliminate the bias caused by releasing national estimates.

Since government statistics and price forecasts have exhibited numerous shortcomings, and since economic conditions remain in a volatile state, it is important for more evaluations such as those reported in this paper to be undertaken. However, in evaluating the shortcomings and strengths of each statistical series, other sources of error than those tested in this project should

Table 3. Summary of analysis of mean-square error of 10-state farrowing intentions reports by survey and quarterly report, September 1959–March 1973[a]

Survey and Quarterly Report[b]	Decomposition of Error MC	 SC	 RC	Square Root *MSE* percentage of actual mean	Forecast mean bias	Rejected as biased and inefficient
Rural Carrier						
I	11.4 %	21.8 %	86.36%	.054%	−1.83%	No
II	39.9	10.12	49.90	.030	−1.89	Yes
III	1.14	.27	98.50	.015	− .16	No
Probability Mail						
I	.09	11.28	88.60	.069	− .22	No
II	14.65	.00	85.34	.051	− .98	No
III	7.62	8.93	83.44	.032	.90	No
Mutiple Frame						
I	17.85	1.03	81.11	.065	2.75	No
II	4.36	.09	95.50	.052	1.09	No
III	7.03	.06	92.90	.024	− .65	No

[a] Figures used for computing statistics appearing in Table 3 are the same as those used for computing *R* statistics in Table 1.

[b] The times when quarterly reports I, II, and III are issued are specified in Table 2.

be considered before making changes in the series. One such error source rarely mentioned is well described by Sir Josiah Stamp [12]:

> The Governments are very keen on amassing statistics. They collect them, add them, raise them to the *n*th power, take the cube root and prepare wonderful diagrams. But you must never forget that every one of these figures comes in the first instance from the village watchman, who just puts down what he damn pleases.

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ABSTRACTS OF AWARD-WINNING THESES

Doctoral Theses

Wyatte Lafayette Harman, ***Evaluating the Growth Potential of Irrigated Farms with Diminishing Water Supplies: A Multiple Goals Approach to Decision-Making*****, Oklahoma State University, 1973.**

The major objective of the analysis is to evaluate the effects of selected factors on growth potential of irrigated farms in the South Central Plains. Factors hypothesized to influence growth potential over a 20-year planning horizon are the underground water supply conditions, current and land equity positions, acreage currently operated, and the family living needs. The firm growth decisions over time are based on multiple goals which may vary in relative importance as farm and family characteristics change. Eight goals included in the analysis are: (1) control more acres by renting or buying, (2) avoid being forced out of business, (3) maintain or increase family living standards, (4) avoid years of low profits or losses, (5) increase leisure time, (6) increase net worth, (7) reduce borrowing needs, and (8) make the most annual profits.

A simulation routine including a multiple-goals decision model for periodically selecting among four strategies, making adjustments in the farm organization, determining the family consumption patterns, and performing the multiperiod cash flow calculations is utilized. The four alternative strategies available for selection are: (1) continue with the present farm organization, (2) purchase additional acreage, (3) rent additional acreage, and (4) release rented acreage to purchase an equivalent amount. The technique develops a hierarchy of goals and separates them into primary and secondary groups. A strategy is selected based on the dominant goal providing the satisfying levels of the primary goals are met. After the plan is implemented and a production period elapses, the farm and family characteristics are assessed and another hierarchy of goals is developed. This process continues until the next decision period is encountered at which time the alternative strategies are evaluated again. The current analysis evaluates them each fourth period following the base period, although the frequency is subject to user modification.

The study evaluates the growth potential of 60 representative situations using current input and product prices, crop and grazing yields, technology, and 1972 commodity programs. The water supply situations are distinguished by 75, 250, and 450 feet of saturated aquifer. The beginning farm situations include three cropland intensive farms of 640, 1,600, and 2,880 acres and a less intensive ranch of 7,040 acres having 4,800 acres of native pasture. Three initial land equity positions of full ownership, part ownership (50 percent), and tenant are also evaluated. The farm operators are initially 25 and 45 years of age with one and three dependents and one and 21 years of farming experience, respectively.

The hypothesized factors are instrumental in affecting the growth potential of irrigated farms over a 20-year planning horizon. Their influence is twofold: they affect the capital accumulation process directly by their level of availability and indirectly by their influence on the relative importance of multiple goals, and hence their influence on the strategy selected. The initial land equity position, farm size, and water supply situation are found to exert relatively more influence on growth potential than age of the operator.

Generally, the growth potential or gain in net worth increases with the initial size of unit, extent of initial land ownership, and age of operator. Having a greater initial saturated thickness of the water-bearing strata does not assure corresponding increases in growth. The model incorporates additional capital requirements as increases in irrigated acreage, additional machinery costs, irrigation facility investments, and land costs occur. These factors result in relatively less growth potential for part owners and tenants as compared to full owners. The tenants, in fact, encounter bankruptcy for all farm sizes in the thickest saturated zone of 450 feet.

Ninety percent of the 60 situations maintain viable and growing firms over the planning horizon. Nearly half of the decisions are to purchase land with the frequency increasing as capital is accumulated. The rental strategy is selected in about 28 percent of the decisions with a decreasing frequency over time. To continue with the present operation accounts for the rest of the decisions leaving no decisions to trade rented land for purchasing an equivalent amount.

The majority of decisions are based on two goals: "increase net worth" and "avoid years of low profits or losses." The next most frequently occurring goals are "reduce borrowing needs" and "avoid being forced out of business." "Increase leisure time" and "make the most profits each year" influenced decisions 11 percent of the time.

David Holman Harrington, ***Quadratic Input-Output Analysis: Methodology for Empirical General Equilibrium Models*****, Purdue University, 1973.**

Economists have been interested in general equilibrium models as academic puzzles and pedagogical devices since Leon Walras (1874) first formulated his general equilibrium model. Until the present, only one empirical model has been derived from the general equilibrium system: Leontief Input-Output Analysis. The Leontief model has been extended and applied in many settings but still remains essentially as specified in his original work. Since then there have been many advances in linear economic models and in computational techniques. It appears that empirical applications of the Leontief model have not kept pace with these recent developments. The research reported in this thesis brings the recent advances in linear economic models and computational techniques to the Leontief Model.

The Walras-Cassel general equilibrium model was reformulated as a quadratic programming problem. The resulting Quadratic Input-Output (QIO) model makes clear the structure of the problem and the necessary specifications upon the form of factor supply and product demand functions. In the linear form of the Walras-Cassel model the assumptions of homogeneity of degree zero of the factor supply and product demand functions can be relaxed inasmuch as the homogeneity constraint is satisfied elsewhere in the model formulation.

The Leontief Input-Output model is shown to be a limiting case of the linearized Walras-Cassel model (the QIO model) with perfectly elastic factor supplies and perfectly inelastic product demands. The QIO model is a theoretical improvement over Leontief Input-Output Analysis inasmuch as the factor and product pricing mechanisms are directly incorporated in the QIO model.

An empirical demonstration model using the United States Input-Output Table for 1963 was constructed and used as both a projective and an analytic model. An 18 sector input-output table and representative consumer demand and factor supply functions were incorporated in the QIO model. The model could be solved as a conventional input-output model or as a QIO model.

The results of the QIO model were compared to the conventional input-output model for the base year, 1963, and two projective years, 1968 and 1973. The results of subjecting both models to an increase in government demand revealed considerable differences in the performance of the QIO model as opposed to the input-output model. Projected changes in outputs differed by as much as ±50 percent in certain sectors. For a 10 percent increase in government demand the QIO model resulted in estimates of price inflation of 1.991 percent with a corresponding increase in real final output of only 0.146 percent with full employment of labor. In an underemployment situation price inflation was 1.857 percent and increase in real final output was 0.396 percent. In an unemployment situation the rate of price inflation and growth of real final output were 0.783 percent and 1.312 percent, respectively. For the conventional input-output model all increased demand was reflected as growth in real final output of 1.972 percent. The price inflation component is assumed away in the conventional input-output model.

The conclusion of this research is that the QIO model is a significant theoretical and empirical advance over the Leontief Model. Its theoretical content is greatly enhanced by the direct inclusion of the pricing mechanism. Its analytic power and empirical content are greatly superior to input-output analysis because of the simultaneous determination of output and price effects of changes in an economy.

JOHN BARTRAM PENSON, JR., *An Aggregative Income and Wealth Model for the U. S. Farm Sector: Its Description and Application to Policy Analysis*, University of Illinois, 1973.

The over-all purpose of this study was to provide the basis for addressing questions of a monetary or fiscal policy nature as they affect the financial structure of the U. S. farm sector. To accomplish this goal, several intermediate steps were required.

Initially, a sources-and-uses-of-funds statement consistent with existing farm sector income and balance sheet accounts was required to give a more complete accounting of the sector's financial structure. These accounts serve two major purposes in this study: (1) provide time series data for investigating hypotheses regarding the desired portfolio balance in the farm sector and the flows of funds to which these desired stocks give rise, and (2) provide an accounting framework for reporting the results from alternative policy simulations.

An empirical investigation of this desired portfolio balance yielded a system of 25 simultaneous equations depicting the sector's demand for physical assets, financial assets, and loan funds. In addition, several ancillary relationships were either estimated or formulated which relate (1) productive assets at the beginning of the year to farm output, (2) quantities marketed to prices received, or (3) yields on securities in the national money market to interest rates charged on new loans to farmers.

An aggregative income and wealth (AIW) simulator was assembled in this study based primarily upon the empirical results achieved from estimating the structural demand equations for assets and loan funds and specific ancillary equations. Other synthesized ancillary relationships which employ elasticities estimated in previous studies were also adopted. The AIW simulator was demonstrated to have a good forecasting ability both within and beyond the sample period used to estimate the regression coefficients. Thus, the user has the option of focusing on alternative policies in either a "counterfactual" or a "futures" context. The AIW simulator allows one to forecast "what would have happened" had a particular policy been introduced in the past or, alternatively, "what will happen" if an alternative policy is introduced now.

Several simulations were made which, while demonstrating the simulator's potential versatility, provide policymakers with intelligence on the likely impacts of specific alternative policies. The AIW simulator was used to address one monetary policy and two fiscal policy alternatives. In addition, the impact of a zero rate of growth in productivity of farm inputs upon the sector's capacity to produce was also examined. Finally, a forecast of the sector's financial structure to January 1975 was presented.

Initially, the recommendation by the President's Commission on Financial Structure and Regulation gradually to abolish the ceiling on interest rates paid on time and savings deposits at insured commercial banks and deposit thrift institutions in general was shown to increase the demand for these deposits significantly by farmers. At the same time, the demand for farm inventories was shown to decline as the relative rate of return on financial claims at commercial banks increases. The over-all impact of this alternative policy, however, was relatively small.

Both price controls on prices received by farmers and a return to free market price determination were shown to have a substantial impact upon the farm sector's financial structure. With net incomes falling substantially, farmers were in a much worse position to service their debt commitments.

Finally, a constant ratio of output to inputs in the sector is shown to increase substantially the rate of return on these inputs due to the inelastic nature of demand for farm output. The percentage of capital formation financed by net cash income will be up substantially, and farmers will be in a much better position to service their debt commitments.

Master's Theses

JAMES E. CASEY, JR., *A General Model for Estimating the Economic and Production Effects of Specified Pesticide Withdrawals: A Cotton Application*, Texas A&M University, 1973.

In 25 years, pesticides have become a major input to commercial agriculture. Even at present levels of use, studies indicate that the returns in agriculture from use of an additional dollar of pesticides are two to three dollars. However, the emphasis on environmental quality has caused considerable pressure to discontinue use of some pesticides, which in turn, raises important questions regarding the impact of withdrawing specific pesticides from commercial use in agriculture. This report discusses a model developed to estimate regional and national effects of specified pesticide withdrawals from cotton production. Included is an evaluation of regional shifts in cropping patterns and associated changes in cotton output, price, and farmer net returns.

Data requirements for the model developed in this study included estimates of yield and production cost change due to pesticide withdrawals. Since data were not available, a relatively new technique called the "Delphi Method" was used to generate this information. The Delphi method uses experts in a subject matter field and a multi-round survey.

These data were used in a general simulation model developed to evaluate regional and aggregate effects of specific pesticide withdrawals. The model was facilitated by a computer program that included five options for estimating the effect of specified pesticide withdrawals.

With cotton acreages held constant in each region, pesticide cancellations caused output to decline. But the expected price increase due to reduced output typically resulted in an increase in aggregate or U. S. net returns to cotton and the alternative crop to cotton. There were, however, some regions that would experience a decline in net returns with particular pesticide withdrawals. Using Option II, which permitted cotton acres to shift among regions, output remained near 9 to 10 million bales while expected net returns to cotton and the alternative crop to cotton increased in every region (compared to the present situation). However, cotton production was totally deleted in some regions, primarily the Eastern United States and Rio Grande Valley of Texas.

With cropping pattern adjustments, pesticide withdrawals in most cases would not have a large effect on cotton acres or output for the U. S. in total. However, for every pesticide withdrawal using each of the options, the regional effect on acres, output, and net returns vary widely. The Carolinas, Florida, Georgia, and South Texas are usually found not to have a comparative advantage for cotton, thus estimated cropping shifts indicate cotton would adjust out of these areas. The other areas of Texas, Louisiana, Arkansas, Mississippi, Alabama, and New Mexico usually retain or gain cotton acres. Arizona and California fluctuated most in cotton acres and output.

These results suggest the effect of pesticide withdrawals may not be large from a national viewpoint but that regional impacts may be of utmost importance. The effects of pesticide withdrawals on rural communities and economies as well as on price paid by consumers need to be carefully compared to the estimated advantages of pesticide withdrawals.

PAUL DENTON SPILLERS, *A Simulation Analysis of the Effect of a Product Tax on the Packaging Waste Output of Selected Food Products*, Purdue University, 1973.

Packaging is a major component of solid waste. About 52 million tons, or 13 percent of all solid wastes is composed of packaging materials, and the food industry accounts for 44 percent of all packaging sales. Taxation is currently being given serious consideration as a policy tool for use in solid waste abatement. High level consideration of this policy is attested by the Resource Recovery Act of 1971.

The objective of this study is to stimulate the effect of a product tax on the packaging waste output of selected food products. Specific objectives include: (1) calculate product tax rates which will internalize the cost of collection and disposal of the packaging waste associated with each selected product, (2) stimulate the impact of the calculated taxes on prices and quantities of each selected product, and (3) estimate the change in quantities of packaging wastes as a result of the exogenous tax.

The analytical tool used in the analysis is electronic computer simulation. A comparative static simulation model is specified and then programmed using FORTRAN IV language. Simulation was used because of the lack of definitive data regarding cost and elasticity of supply parameters. Three cases, each consisting of 36 experiments, are simulated. The cases encompass what is believed to be a reasonable range of these parameters.

The results indicate that relatively small taxes (generally less than one cent per pound) are sufficient to internalize what are believed to be reasonable levels of collection and disposal costs associated with the selected products. The results indicate that the tax incidence, which is a functional relationship between elasticity of demand and assumed supply elasticities, is distributed between both producers and consumers. A portion of the tax (the amount depends upon the assumed supply elasticity) is absorbed by producers and the remainder is absorbed by the consumer. Within what are believed to be reasonable levels of supply elasticities, the results show that producers would absorb a greater portion of the tax. Because of this incidence structure, the results indicate only a minimal increase in product prices. The aggregate price level, as measured by Fisher's Ideal Index, is increased by less than 1 percent. These relatively small price increases result in a decrease in aggregate consumption of these products of less than one-half of 1 percent. The results indicate that the tax rates would reduce the aggregate quantity of packaging wastes by less than 2 percent.

ANTHONY C. ZWART, *A Recursive Spatial Analysis of the North American Pork Sector,* University of Guelph, 1973.

The main objective of this research is to develop a working model of the North American hog-pork sector which can be used in analyzing effects of policy or structural changes on that sector. Such changes are measured in terms of the repercussions over time and space.

The study considers first the spatial and temporal characteristics of the sector and develops the hypothesis that its behavior can be represented in a spatially competitive framework which includes the intertemporal links of storage stocks and lagged supply functions.

The model is a quarterly spatial price equilibrium model which considers three major regions in North America: United States, Western Canada, and Eastern Canada. Behavioral equations were estimated for supply of pork, consumption demand for pork, and the storage demand for pork in each of the regions using actual quarterly data for the period 1961 to 1971. These equations which give accurate predictions of the dependent variables were utilized in a quadratic programming model to determine the optimum quarterly prices, consumption, storage stocks, and trade. A recursive element was included in the complete model in two ways. First by using equilibrium price solutions in determining supply levels in later quarters, and second, using equilibrium closing stock levels in one quarter as the opening stock level in the next quarter.

The model was validated by simulating market behavior for the period 1968–1971. Results from this validation showed the model had the ability to predict levels of: production, prices, consumption, storage, and trade in consecutive quarters in each region. The above results supported the conclusion that the North American pork sector behaves in a spatially competitive manner over time which made it possible to use the model in simulating market behavior.

The model is used in this study to analyze the effects of a change in the tariff structure for pork traded between Canada and the United States. This example is used to show the ability of the model to determine the repercussions of policy changes over time and space. Results were presented in terms of the effects on variables such as production, consumption, prices, and trade, and the effects on consumer and producer welfare in each region.

Results of the experiment showed that the effects of such a policy change tend to be generally more complex than would be suggested by a simple static analysis. This shows the ability of the model to measure closely the effects of policy on structural changes on the sector, and to present the policymaker with valuable information in terms of physical and welfare changes in each of the regions over time. The model is readily adaptable to the analysis of a wide number of situations; as well, it has the ability to be used in short-run prediction of behavior in the pork sector.

AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION REPORTS AND MINUTES

REPORT OF THE PRESIDENT

It was a very active year for the American Agricultural Economics Association. I will not attempt to summarize the work of all the committees and other activities of the Association during the year but only mention the highlights of some of the more important decisions and activities. First, may I express my great appreciation and congratulate the faculty and administration of Texas A&M University for the outstanding manner in which they planned and presented the 1974 Summer Meeting.

One of the more important events of the year was the change in the editorship of the journal. Dr. Leo Polopolus and Dr. M. R. Langham from the University of Florida are to be commended for the very effective way they served as co-editors. Dr. W. G. Tomek from Cornell University will be the new editor, beginning with the February 1975 issue of the journal. The journal was also approved by the Board for copyright beginning with the February 1974 issue. One of the more active and important committees was the one engaged in evaluating the journal. Under the fine leadership of Dr. Stephen C. Smith, the committee's report has some very significant results which are also timely because of the shift in the journal's editorship responsibilities. Another committee was appointed to look further into the recommendations of Dr. Smith's committee to determine how these might be implemented.

In response to requests from the membership, ballots were mailed first class this year. In the coming year, the last notice for dues to be paid will also be mailed first class.

The Board voted to return to a university campus for the 1978 annual meeting. Invitations will be solicited and a decision made during the 1974 Winter Meeting.

The Resident Instruction Committee, chaired by Dr. Wayne Purcell, recommended student contests be discontinued after 1974 and that new activities or programs be developed which facilitate involvement of undergraduate students as an integral part of ongoing American Agricultural Economics Association activities. The recommendation was accepted by the Board. The Board asked the committee to plan more meaningful student activities which would be both helpful to the student and oriented to the teacher. The new chairman of the Resident Instruction Committee will continue to work with the new President in terms of the role that student-teacher activities should play in the summer meeting.

The Membership Committee, chaired by Dr. John Lee, was very active this past year. The committee included Vice Presidents from each of the regional associations. I am pleased to report an increase in the membership of our Association during the past year.

The International Committee, which was chaired by Dr. Lyle Schertz, received a grant from The Rockefeller Foundation to analyze foreign activities in the area of student training.

The Bibliographical Committee made recommendations regarding the future of this area of work and received approval of the Board for a retrospective search system. We hope that this will be of great assistance to the Association during the future.

Due to inflation and increased services, the proposed 1975 budget of the American Agricultural Economics Association showed an approximate $30,000 budget deficit. The Board of Directors approved a $40.00 per journal page charge to overcome the budget deficit and to put the American Agricultural Economics Association on sound financial basis. The $40.00 per page charge to employers of journal authors will include 100 free reprints to payers of the charge. The membership supported the action of the Board by defeating a motion to delay the journal page charge and substitute an annual membership dues increase of $10.00. The page charge will be implemented during this fiscal year.

Serving as President of the American Agricultural Economics Association was a most meaningful and rewarding experience for me. I will always be indebted to the Association for awarding me the opportunity and privilege of serving as President.

K. R. Tefertiller, *President*

RESOLUTION

We wish to acknowledge the warm and cordial hospitality shown the members of the American Agricultural Economics Association, their families and guests, on the occasion of the annual meeting held at Texas A&M University on August 18–21, 1974. Therefore,

BE IT RESOLVED that the American Agricultural Economics Association expresses its sincere gratitude to President Jack K. Williams, Mr. Charles Cargill, Director of the Tower Complex, and to John A. Hopkin, Chairman of the Department of Agricultural Economics and Rural Sociology and his faculty, staff, and students and their families for their hospitality.

All of these, under the able and devoted leadership of Clive R. Harston, Chairman of the Local Arrangements Committee, as constituted and reported on pages 32–34 of the program, have served us effectively and graciously.

BE IT FURTHER RESOLVED that a copy of this Resolution be sent to President Jack K. Wil-

Table 1. Number of members and subscribers, 1973, with comparisons

Category		1968	1969	1970	1971	1972	1973
Institutional Members		38	45	39	34	25	20
Regular Members	—U.S.	2716	2854	2667	2856	2802	2504
	—Foreign	547	566	534	486	601	487
Junior Members	—U.S.	585	518	494	635	398	316
	—Foreign	82	61	84	53	38	161
Corresponding	—U.S.	—	2	4	2	—	—
	—Foreign	187	179	95	100	82	184
Libraries & Bus.	—U.S.	594	645	596	619	647	635
	—Foreign	1024	1090	1031	1111	1196	1168
Exchange		3	3	3	2	2	3
Total		5776	5963	5547	5898	5791	5478

Table 2. The 1973 operating statement with comparisons and 1974 budget

Item	1972 Actual	1973 Budget	1973 Actual	1974 Budget
Income:				
Dues and Subscriptions:				
Regular Members	$ 55,645.52	$ 60,000	$ 56,513.62	$ 56,000
Junior Members	3,441.25	3,500	1,983.84	3,400
Subscriptions	38,193.82	31,000	35,141.97	37,000
Corresponding	240.00	500	840.00	200
Institutional	2,500.00	3,500	2,000.00	2,500
Am. Bibliography	11,478.85	5,000	5,230.87	5,000
Dividends & Interest	7,459.67	7,000	7,799.37	7,400
Journal Sales	11,174.00	5,000	4,444.89	5,600
Reprints	3,244.90	3,600	3,259.31	3,000
Address Labels	844.22	—	835.12	500
Advertisements	623.00	600	1,065.00	600
Student Activities	250.00	250	—	250
Annual Meetings	3,833.15	700	344.67	700
Employment Committee	—	—	37,500.00	—
Miscellaneous	2,900.64	3,000[a]	5,026.90	3,000[a]
Total	$141,829.02	$123,650	$161,985.56	$125,150
Expenses:				
Journal Printing	$ 65,927.17	$ 72,000	$ 70,483.40	$ 52,500
Editorial Support	15,600.00	15,600	15,600.00	23,400
Printing Reprints	1,863.02	2,500	1,843.76	2,000
Address Labels	273.72	300	316.23	200
Purchase Journals	2,283.76	1,500	1,028.80	2,000
Postage & Phone	2,527.50	2,200	1,679.09	2,600
Off. Supplies & Printing	2,099.37	2,000	2,932.18	2,500
Annual Meeting	1,305.14	2,500	1,485.46	2,500
Awards	3,068.00	800	600.00	800
Committees	1,244.46	2,000	272.68	1,200
Bonds	149.00	160	298.00	160
Student Activities	1,131.99	1,200	842.90	1,200
Sec-Treas. Assistance	12,266.96	14,500	12,851.48	15,900
Sec-Treas. Honorarium	4,000.00	4,000	4,000.00	4,000
Am. Bibliography	6,507.70	7,500	7,729.33	7,000
IAEA Grant	—	5,000	5,000.00	—
Audit	—	—	—	1,000
Employment Committee	—	—	12,399.66	—
Miscellaneous	834.81	4,000[a]	9.76	4,000[a]
Total	$121,082.60	$137,760	$139,372.73	$122,960
Balance	$ 20,746.42[b]	$ 14,110	$ 22,612.83[b]	$ 2,190

[a] Includes $2,000 advance and/or repayment.

[b] The total liability for the November and December 1972 journals was $35,449.45 and had been estimated and recorded at $30,000.00, since invoices did not arrive until May 1973. The corresponding liability for the November and December 1973 journals had been estimated and recorded at $30,000.00. The actual liability was $30,704.67. This resulted in net income for 1972 being overstated by $5,499.45 and 1973 net income being understated by $4,744.78. In the future, the statements will be prepared after the invoices are certain, making the statements more accurate.

liams, Mr. Cargill, Dr. Hopkin, Dr. Harston, and to each member of his committees and to others at the Texas A&M University as appropriate.

RESOLUTION

Acknowledging the support given to the *American Journal of Agricultural Economics* during the past three years.

BE IT RESOLVED that the American Agricultural Economics Association expresses its great appreciation to the University of Florida for providing the services of two of its ablest faculty members, Leo Polopolus and Max R. Langham, to serve as Co-Editors of the *American Journal of Agricultural Economics*. Special thanks are also due to their editorial colleagues and assistants. In addition, the Association wishes to express its deepest appreciation to Professor Peter G. Helmberger of the University of Wisconsin for serving as Book Review Editor.

BE IT FURTHER RESOLVED that a copy of this Resolution be sent to the appropriate administrative officials of the University of Florida and the University of Wisconsin.

REPORT OF THE SECRETARY-TREASURER

The total number of members and subscribers declined in 1973 to the lowest level in recent years (Table 1). All categories experienced a reduction except Foreign Junior members and Foreign Corresponding members. It was interesting to note that 127 U. S. Junior members in 1972 failed to renew their membership in 1973. The Institutional membership declined to a low of 20 members.

The 1973 operating statement shows a surplus of $22,612.83 (Table 2). Such statements show the extraordinary items as a normal operating activity. This statement includes the unspent funds of $25,100.34 from the grant by the U. S. Department of Labor. When this item is accounted for in both income and expense categories, the AAEA experienced a deficit of $2,487.51 instead of the budgeted deficit of $14,110.42. In the miscellaneous income category are included such items as $1,299.79 from Educational Workshop, $2,000 as loan repayment, $200 from gifts, $185.90 from sale of brochures, $450 as IAEA refund, and $464.69 as royalty from Xerox.

We were able to enhance our income from membership dues by writing personal letters to "old" members who had let their membership elapse from two to three years. Surprisingly, we received a sizable sum of money in back dues. Experience leads me to believe many members of our profession are careless in payment of dues.

As usual, every effort has been made to hold expenses down where possible. The one item which particularly stands out is reduction in committee expense. When the $12,399.66 expense item associated with our grant is considered, we were able to reduce our budgeted expense by nearly $11,000.00.

At the Edmonton meeting, it was requested that an accounting of the editorial support provided by AAEA be made by the Editor to provide for completeness of the financial records. An income-expense statement provided by the Editor for 1973 shows a deficit of $2,649.49 (Table 3).

The American Bibliography of Agricultural Economics will need an increasing amount of subsidy from AAEA. The cost of printing has been increasing and the income from subscriptions declining.

AAEA MEMBERS:			
Year	New	Renewal	Total
1972	185	—	185
1973	23	98	121
1974 (May 20)	6	63	69
LIBRARIES:			
1972	383	—	383
1973	56	333	389
1974 (May 20)	17	280	297

It is currently costing AAEA about $2,000 per issue to prepare, print, and mail. As you know, the labor input is provided by USDA and AAEA.

The Balance Sheet for AAEA showed an increase of $22,612.33 in net worth over 1972 (Table 4). However, when $25,100.34 unspent grant funds are accounted for, we realize a loss of $2,487.51, making our net worth actually $127,644.74. Our stock is carried on the books at cost. As you can see, the stock market has been unkind to us, giving a "paper loss" of $31,230,625 for the year.

The problem of inflation appears to be our most pressing problem. We changed printers to ease the expense burden, but that gave only a breathing spell for a year. The fact which still remains is that $15.00 is an exceptional bargain for dues in one's professional society.

The year has been a challenging one.

Respectfully submitted,
John C. Redman, *Secretary-Treasurer*

Table 3. The operating statement of editorial support, 1973

Income:	
AAEA Appropriation to AJAE	$15,600.00
Interest on savings account	830.70
Total	$16,430.70
Expenses:	
Postage	$ 802.55
Copywork	387.85
Telephone	387.94
Supplies	240.31
Salaries: (including fringe benefits)	
Editorial Assistant	10,427.08
Secretary	6,834.46
Total	$19,080.19
Balance	$ 2,649.49

Table 4. Balance sheet, December 31, 1973, with comparisons

Item	1971	1972	1973
Assets:			
Cash-Bank	$ 46,805.43	$ 63,540.82	$106,217.77
Cash-Agency Act. UK	921.27	1,559.27	(135.99)
Cash-Broker	7,338.59	14,788.27	2,123.08
Investments:			
Stocks (at cost)	$102,551.99	$102,551.99	$102,551.99
(Approximate market value)	194,777.25	214,096.75	182,866.125
Total assets (at cost)	$157,617.28	$182,440.35	$210,756.85
Liabilities:			
Prepaid Membership Dues	$ 35,173.35	$ 22,192.00	$ 27,895.67
Prepaid ABAE Subscriptions	942.00	—	—
Accounts Payable	12,116.10	30,116.10	30,116.10
Net Worth	$109,385.83	$130,132.25	$152,745.08
Total Liabilities	$157,617.28	$182,440.35	$210.756.85

REPORT OF THE INVESTMENT COMMITTEE

The portfolio of investments by AAEA did not change during 1973. The stocks carried on the books at cost of $102,551.99 had a market value of $182,866.125 at the close of the business year, decreasing by $31,230.625 from the previous year (Table 1). Our investments in stocks yielded $7,799.37 in dividends and interest (Table 2).

The AAEA had only three stocks—Chase-Manhattan, Exxon, and Standard Oil of Indiana—which were worth more at the end of 1973 than at the beginning. Based on cost, a 7.6 percent rate of earnings was realized, but when based on market value at the beginning of the year, only 3.64 percent was realized.

Respectfully submitted,
John C. Redman,
Chairman, Investment Committee

Table 1. AAEA Summary of investments, year ending December 31, 1973

	Income	Value	
	Jan. 1-Dec. 31, 1973	Cost	Market
Stocks:			
On hand, Jan. 1, 1973		$102,551.99	$214,096.75
On hand, Dec. 31, 1973		102,551.99	182,866.125
Dividends & Income	$7,799.37		

Table 2. AAEA stocks, December 31, 1973

Company*	No. of Shares	Original Cost	Dividends 1973	Market Value	
				Dec. 31, 1972	Dec. 31, 1973
Am. Cyanamid (A)	250	$ 9,143.43	$ 331.26	$ 8,000.00	$ 4,843.75
Am. Tel & Tel (A+)	288	11,421.11	806.40	15,192.00	14,436.00
Am T&T $4CV (AA)	300	16,934.00	1,200.00	18,300.00	17,212.50
Borden (A+)	228	2,162.41	273.60	7,182.00	4,788.00
Chase-Manhattan (A+)	93	1,115.09	186.00	5,208.00	5,254.50
Clark Equipment (A—)	600	2,200.67	906.00	32,550.00	27,900.00
Com Edison (A)	232	7,467.14	527.80	8,323.00	6,757.00
Cont. Can (A)	225	4,315.38	360.00	6,834.375	4,612.50
Exxon (A+)	153	10,325.36	650.25	13,387.50	14,401.125
Goodyear (A)	500	16,692.50	479.50	15,750.00	7,625.00
Jewell (A)	100	3,875.94	166.00	5,412.50	3,112.50
Nor. Ill. Gas (A)	7	—	13.32	193.375	152.25
Sears Roebuck (A+)	304	1,845.38	504.64	35,264.00	24,396.00
Std Oil Ind (A+)	400	7,356.68	1,033.60	35,000.00	41,500.00
Texaco (A+)	200	7,696.90	346.00	7,500.00	5,875.00
Interest from broker			15.00		
Total		$102,551.99	$7,799.37	$214,096.75	$182,866.125

* Standard & Poor Ratings shown in parentheses.

REPORT OF THE EDITOR

Since this report represents our swan song as editors, we feel rather at peace with both the job and you, the membership of the Association. If you have words of kindness, we will be happy to receive them. Otherwise, we refer you to the new editor and his associates—Drs. William G. Tomek, Richard N. Boisvert, and Donald K. Freebairn of Cornell University and Francis E. Walker of Ohio State University.

Major developments involving the *Journal* during the past year include:

1. a successful transition to a new printer, Heffernan Press Inc., Worcester, Massachusetts, after 46 years with the George Banta Company Inc., Menasha, Wisconsin;
2. an indoctrination of the new editors and an ongoing transfer of the responsibilities of the Office of Editor;
3. some changes in the *Journal* itself; and
4. abstracting contributed papers in the December 1974 issue.

The first three items are discussed in turn.

The Heffernan Press is doing a good job. They have been sensitive to our requests, and they have done an excellent job of typesetting and of proofing their work. As a consequence, their output is definitely more error-free than was Banta's. We also feel that their final product is well done. They have given a marginal improvement in quality at a reduced cost. In today's world, those accomplishments are gratifying.

In April Drs. Tomek and Boisvert visited our office to get a first look at the duties of the Office of Editor. Since then we have completed manuscript selection for the 1974 volume, and this duty has been completely transferred to the new regime at Cornell University. The remaining issues for Volume 56 (August, November, and December) are on schedule.

In keeping with the action of your Board of Directors, the *Journal* has been copyrighted beginning with the February 1974 issue. We have also started providing information on when the published articles were received and revised. This information for each article is placed immediately before the list of references. Lastly, in the August issue you will note the addition of the names of deceased persons in the obituary section of the Table of Contents.

During the past year we received 285 new submissions, an increase of 22 over 1972–73 (Table 1) and the largest number received in any one year by the *Journal.* Our acceptance rate remained at 34 percent. There was a slight increase in the number of articles accepted, a large increase in communications, and a reduction in short articles (Table 2). We have had a high acceptance rate for communications; so, the large increase in the number of communications gives an upward bias to our effective acceptance rate.

The effect on the *Journal* of Leo Polopolus' promotion to department chairman was minimized by the excellent service of Drs. Robert D. Emerson and Lester H. Myers as associate editors. We are grateful to them. Marcia Heighton has continued her very capable services in the difficult and trying position of editorial assistant, and Dorothy Vieira performed in an outstanding fashion as *Journal* secretary. Peter G. Helmberger has been his own man as Book Review Editor. His performance of those duties has been first rate, and we extend our appreciation to him for a job well done.

Table 1. New *AJAE* submissions, manuscripts accepted, and the acceptance rate 1960/61–1973/74

Period	Number of New Submissions[a]	Number of Manuscripts Accepted for Publication	Manuscripts Accepted as a Percent of New Submissions
1960/61	140[b]	70[b]	50[b]
1961/62	140[b]	70[b]	50[b]
1962/63	167	77	46
1963/64	162	77	48
1964/65	184	80	43
1965/66	218	87	40
1966/67	195	96	49
1967/68	212	100	47
1968/69	268	105[b]	39[b]
1969/70	249	95[b]	38
1970/71	250	96[b]	38
1971/72	264	96	36
1972/73	263	90	34
1973/74	285	98	34

[a] Excludes proceedings papers and book reviews.

[b] Estimated.

Table 2. Number of *AJAE* articles, notes, and communications published excluding proceedings papers and book reviews, 1971–1974

	1971	1972	1973	1974
Articles	41	30	22	25
Research Notes	23	—	—	—
Short Articles/Notes	—	37	49	40
Subtotal	64	67	71	65
Communications	32	29	19	33
Total	96	96	90	98

Our Editorial Council assisted extensively with the manuscript evaluation function, and they again played a major role in the difficult task of selecting the Outstanding *Journal* Article for 1973. The 1974 Editorial Council members were Ludwig Auer, Michael Brewer, John P. Doll, Clark Edwards, Vernon Eidman, Lehman B. Fletcher, Yujiro Hayami, Bruce F. Johnston, Marvin W. Kottke, Arthur B. Mackie, William E. Martin, Daniel I. Padberg, Roy G. Stout, Takashi Takayama, Henry A. Wadsworth, and Francis E. Walker. We are grateful to them.

We express our very deep appreciation and heartfelt thanks to the over 300 members and other economists who gave of their time to review and comment on the manuscripts we received. Their names are listed in Table 3. The list includes only those with whom we corresponded and does not include the many colleagues of reviewers who also entered the process in an indirect way. The evaluation of manuscripts is very costly in terms of professional time, and one of the most gratifying aspects of the editorship has been to see how generously and willingly professionals support this activity with their valuable time.

Regardless of *Journal* appearances and what many of you may have come to believe, your *Journal* editors do feel considerable pressure to publish materials with an extension, teaching, and industry orientation. In his 1971 report Varden Fuller admitted to a bias in favor of such articles and we must too. This bias, however, does not seem to stimulate much response, and the editors are essentially limited to the selection of worthy articles from those they receive. Another bias to which we admit in parting is toward the young and the old (officially retired or near retirement) of our profession. We have felt that the *Journal* provides, to its benefit, a means of encouraging youth and the continued productivity of the older and wiser in the profession.

In parting we want to express appreciation to the University of Florida and the colleagues in our department for the support and goodwill given to the Office of Editor; and our gratitude is extended to the Association for the opportunity to have been a part of its *Journal.*

MAX R. LANGHAM AND
LEO POLOPOLUS, *Co-Editors*

Table 3. *AJAE* reviewers, Volume 56

Reviewer
Martin E. Abel
Dale W. Adams
John W. Adams
Eliseu R. Alves
Marvin S. Anderson
Christopher O. Andrew
Kurt Anschel
Harry W. Ayer
Emerson M. Babb
C. B. Baker
Randolph Barker
Raleigh Barlowe
Terry Barr
Peter J. Barry
Larry L. Bauer
D. Lee Bawden
Bruce Beattie
Neil Beckwith
Jere Behrman
Frederick W. Bell
Lee Benham
Kul B. Bhatia
Arlo W. Biere
Ray V. Billingsley
Leo V. Blakley
Michael D. Boehlje
Robert W. Bohall
Richard N. Boisvert
James T. Bonnen
Jean-Marc Boussard
Kenneth Boutwell
John R. Brake
George Brandow
Robert E. Branson
Harold F. Breimyer
George Brinkman
E. E. Broadbent
Daniel W. Bromley
R. M. Brooks
William G. Brown
W. Keith Bryant
Oscar R. Burt
Rueben C. Buse
Gerald Campbell
Joe R. Campbell
Wilfred V. Candler
Thomas Cargill
Thomas A. Carlin
Daryl Carlson
Gerald A. Carlson
Hoy F. Carman
Anne P. Carter
George L. Casler
Emery N. Castle
James C. Cato
Duane Chapman
Dean Chen
Joyce T. Chen
Wen-Shyong Chern
Chauncey T.K. Ching
S. F. Chu
Allesandro Cignio
Dale K. Colyer
Howard E. Conklin
Michael B. Connolly
Richard Courtney
Keith Cowling
Robert W. Crown
Raymond Daniel
Carlton G. Davis
Ernest E. Davis
Lee M. Day
Brady Deaton
Alain de Janvry
J. Delphendahl
John L. Dillon
Gerald A. Doeksen
Robert Dorfman
Peter P. Dorner
Folke Dovring
Kamal Dow
Norman J. Dudley
W. F. Edwards
Carl K. Eicher
D. A. Eiler
Donald J. Epp
Robert E. Evenson
Walter P. Falcon

Table 3. *AJAE* reviewers, Volume 56—Continued

Reviewer

Donald E. Farris
Raymond Farrish
Jerry A. Fedeler
Richard S. Fenwick
John N. Ferris
Lyle P. Fettig
Robert M. Finley
Walter L. Fishel
Dennis U. Fisher
Richard J. Foote
John R. Franzmann
Donald K. Freebairn
John W. Freebairn
A. Myrick Freeman III
Ben C. French
R. J. Freund
Gene A. Futrell
Bruce Gardner
P. S. George
Paul Gessaman
Micha Gisser
T. F. Glover
Ray A. Goldberg
Darrel Good
Frank M. Goode
William D. Gorman
Roger W. Gray
Brook A. Green
R. Clyde Greer
Wade L. Griffin
Zvi Griliches
Robert L. Gustafson
Thomas F. Hady
Richard C. Haidacher
Milton C. Hallberg
James L. Hamilton
Joel R. Hamilton
Charles R. Handy
David E. Hansen
Ian W. Hardie
Claude C. Haren
Paul R. Hasbargen
Joseph Havlicek, Jr.
Marvin L. Hayenga
P. B. R. Hazell
J. C. Headley
James Heckman
R. G. Heifner
John D. Helmberger
Peter G. Helmberger
Robert W. Herdt
William M. Herr
Stephen Heimstra
Royce A. Hinton
James C. Hite
Irving J. Hoch
David L. Holder
David Holland

Reviewer

James S. Holt
John Holt
Paul J. Hooker
Dale Hoover
Ann R. Horowitz
J. P. Houck
Wallace E. Huffman
Paul D. Hummer
Verner G. Hurt
Loren A. Ihnen
John E. Ikerd
George D. Irwin
J. J. Jacobs
Robert E. Jacobson
J. Dean Jansma
Mark Jelavich
Glenn Johnson
R. Bruce Johnson
Stanley R. Johnson
Richard E. Just
John E. Kadlec
Paul Kau
Earl W. Kehrberg
E. D. Kellogg
Robert W. Kennard
David E. Kenyon
Waldon R. Kerns
Gordon King
Richard A. King
Yoav Kislev
R. C. Kite
Jan Kmenta
Kenneth R. Krause
Raymond Krofta
Ronald D. Lacewell
Zarrel V. Lambert
Lawrence J. Lau
George E. Lee
T. C. Lee
Dennis Leech
Uma J. Lele
R. M. Leuthold
Theodore P. Lianos
Edna Loehman
Burl F. Long
Yao-Chi Lu
Francis P. McCamley
Stephen L. McDonald
John B. McNeely
John G. McNeely
W. W. McPherson
J. Patrick Madden
Lester V. Manderscheid
William T. Manley
R. J. Marasco
Lee R. Martin
Yoshihiro Maruyama
W. Kary Mathis

Reviewer

John W. Mellor
Charles W. Meyer
Thomas A. Miller
Theo F. Moriak
Collette Moser
Allan G. Mueller
W. F. Mueller
Yair Mundlak
Charles Nisbet
Richard B. Norgaard
Virgil J. Norton
Ronald A. Oliveira
Frank Orazem
Terutomo Ozawa
A. Parikh
Quirino Paris
Edith H. Parker
E. C. Pasour, Jr.
George F. Patrick
Allen B. Paul
Scott R. Pearson
John B. Penson, Jr.
George Perkins
Richard K. Perrin
Willis L. Peterson
Mindy Petrulis
David E. Pingry
James S. Plaxico
Stanley R. Pliska
Anthony A. Prato
Don D. Pretzer
Frederick J. Prochaska
Francisco Proenza
J. C. Purcell
Wayne D. Purcell
Calvin Quance
Alan Randall
Polturi Rao
Norman Rask
Richard Raulerson
Philip M. Raup
Gordon Rausser
Daryll Ray
Assaf Razin
John C. Redman
Clarence A. Reed
Robert D. Reinsel
John E. Reynolds
Harold M. Riley
Sujit K. Roy
Vernon W. Ruttan
Gian S. Sahota
K. Sasaki
Pasquale L. Scandizzo
Richard Scheffler
Andrew Schmitz
Lee F. Schrader
Dean Schreiner

Reviewer

Ronald A. Schrimper
G. Edward Schuh
John T. Scott, Jr.
James A. Seagraves
Stanley K. Seaver
W. D. Seitz
James D. Shaffer
Mathew D. Shane
Inderjit Singh
Frank Sloan
Allen Smith
Heinz Spielmann
Thomas L. Sporleder
Joseph H. Stafford
William J. Staub
Martin S. Stauber
W. Scott Steele
John G. Stovall
John Subat
P. A. V. B. Swamy
Earl R. Swanson
Hovav Talpaz
Anthony M. Tang
Lester Taylor
Wayne R. Thirsk
Wayne Thomas
C. Peter Timmer
Ronald Tinnermeier
George Tolley
William G. Tomek
William D. Toussaint
Peter Tryfos
Luther G. Tweeten
Fred H. Tyner
Edward W. Tyrchniewicz
Joseph N. Uhl
Roy N. Van Arsdall
Warren H. Vincent
J. A. Von Pischke
John J. Waelti
Luther T. Wallace
Ronald W. Ward
Donald A. West
J. G. West
T. K. White
Norman K. Whittlesey
M. R. Wickens
Joe Willet
Willard Williams
Robert R. Wilson
Larry J. Wipf
Jasper Womach
Dan Yaron
Pan A. Yotopoulos
Glenn A. Zepp
Pinhas Zusman

REPORT OF THE AWARDS COMMITTEE

The Awards Committee completed its first year of operations using the revised awards program approved by the Executive Board and Association at the August 1973 meeting in Edmonton. The Awards Program is carried out by six relatively autonomous subcommittees, each of which receives nominations, establishes a set of procedures for selecting winners, and makes the final choices. Three of the awards remain very much the same as they were before the 1973 revisions. These are the Undergraduate Teaching, Masters Thesis, and Doctoral Thesis competitions.

Three new or revised programs were established. These are (1) Extension Teaching, (2) Published Research in two categories—discovery and communication, and (3) Published Research—enduring quality. All three sub-committees have made some initial judgments about their respective experiences in this first year with new programs.

Dr. Jean Wyckoff, chairman of the Extension Awards program under both the old and revised system, reported that the new program worked well. It parallels the undergraduate teaching awards and seems to be well understood.

Dr. Gene Swackhammer, chairman for Published Research—Communication and Discovery, reports a satisfactory but complex first year.

Many of the nominators did not designate for which category—communication or discovery—they wished the publication to be considered. The next Awards announcement will specify that such a designation must be made by the nominator if it is to be considered by one of the two sub-groups in competition. A few more of the selection criteria for each category will be included in the next announcement.

The new sub-committee, chaired by Earl Swanson, established procedures to select one publication for its enduring quality and excellence from the profession's literature between 1963 and 1968. The committee wishes to propose some modifications in the general announcement for the award. It may propose a change in the time period from which the publication is to be selected. This sub-committee will meet August 19, 1974, to consider possible suggestions for the 1974–75 program and review by the Executive Board.

As retiring chairman of the Awards Committee, I would like to recognize the substantial work of the six sub-committee chairmen in organizing and implementing each of the parts of the overall awards program. They have carried out this substantial activity effectively and met all the required deadlines. The 60 members of this set of committees deserve the commendation of the Association for the time and effort they have given to this important activity. The three year rotation system for committee membership works well. Regional representation from a broad cross-section of the Association's membership exists and can be maintained. The effort to list nominees as well as winners in the Awards Program Announcement seems to have been well received. So has the format used for the awards ceremony itself. It has been a pleasure for me to work with Presidents Castle and Tefertiller.

B. F. Stanton, *General Chairman*

AWARD WINNERS

Distinguished Extension Teaching

Less than 10 years

Stephen B. Harsh, assistant professor, Michigan State University, *Farm Management and Production Economics.*

10 or more years

Emerson Babb, professor, Purdue University, *Agricultural Marketing.*

Distinguished Undergraduate Teaching

Less than 10 years

Glenn C. Himes, associate professor, Ohio State University, *Agricultural Marketing.*

10 or more years

Lester V. Manderscheid, professor, Michigan State University, *Econometrics.*

Unpublished Research Awards

Doctoral Theses

Wyatte L. Harman, *Evaluating the Growth Potential of Irrigated Farms with Diminishing Water Supplies: A Multiple Goals Approach to Decision-Making,* Oklahoma State University; adviser: Vernon R. Eidman.

David H. Harrington, *Quadratic Input-Output Analysis: Methodology for Empirical General Equilibrium Models,* Purdue University; adviser: Earl W. Kehrberg.

John B. Penson, *An Aggregative Income and Wealth Model for the U. S. Farm Sector: Its Description and Application to Policy Analysis,* University of Illinois; adviser: C. B. Baker.

Master's Theses

James E. Casey, Jr., *A General Model for Estimating the Economic and Production Effects of Specified Pesticide Withdrawals: A Cotton Application,* Texas A&M University; adviser: Ronald Lacewell.

Paul D. Spillers, *A Simulation Analysis of the Effects of a Product Tax on the Packaging Waste Output of Selected Food Products,* Purdue University; adviser: Joseph Havlicek, Jr.

Anthony C. Zwart, *A Recursive Spatial Analysis of the North American Pork Sector,* Ontario Agricultural College, University of Guelph; adviser: L. J. Martin.

Published Research Awards

Quality of Discovery

Maurice M. Kelso, William E. Martin, and Lawrence E. Mack, *Water Supplies and Economic Growth in an Arid Environment,* The University of Arizona Press, Tucson, Arizona, 1973.

Leroy Blakeslee, Earl O. Heady, and Charles

F. Framingham, *World Food Production, Demand, and Trade,* Iowa State University Press, Ames, Iowa, 1973.

Quality of Communication

Fred A. Mangum, Jr., *Environmental Waste: Causes and Solutions,* North Carolina State University, Southern Extension Public Affairs Committee Publication 2, 1973.

Truman F. Graf and Robert E. Jacobson, *Resolving Grade B Conversion and Low Class 1 Utilization Pricing and Pooling Problems,* College of Agriculture and Life Sciences, University of Wisconsin, 1973.

PUBLICATION OF ENDURING QUALITY AWARD

Frederick V. Waugh, *Demand and Price Analysis,* USDA Technical Bulletin 1316, November 1964.

OUTSTANDING ARTICLE IN *AJAE*

Robert H. Haveman, "Efficiency and Equity in Natural Resource and Environmental Policy," *Am. J. Agr. Econ.* 55:868–878, Dec. 1973.

REPORT OF THE COMMITTEE ON ECONOMIC STATISTICS AND THE JOINT ASA-AAEA COMMITTEE ON AGRICULTURAL STATISTICS

Economic Statistics Committee

The Economic Statistics Committee continues to work through its two primary task forces. The composition of these task forces is the same as reported last year. The Task Force on Food and Fiber Statistics, chaired by Jim Hildreth, held a conference in Washington, D. C., on October 29–30, 1973, with representatives of the Office of Management and Budget, Bureau of the Census, and the Economic Research Service and Statistical Reporting Service of the U. S. Department of Agriculture. Professor Karl Fox of Iowa State University who had just begun a brief evaluation of 1973 food price forecasting for the Subcabinet Committee on Economic Statistics was also present. The purpose of the conference was to exchange ideas on new approaches to food and fiber statistics currently under development in the research process. The Committee anticipated that the research ideas reviewed or generated by this conference might be the basis for a session at the August 1974 AAEA meetings at which it was hoped some new concepts and statistical system ideas could be presented. Two years ago at the 1972 August AAEA meetings in Gainesville, Florida, the Economic Statistics Committee presented a progress report to the Association in which it attempted to describe the causes of the perceived decline in the performance of data in economic analysis, the most serious of which we found to be conceptual obsolescence. Now, two years later a session on "Measuring the Reality of Modern Agriculture: New Concepts and Statistical Systems" has been organized by the Economic Statistics Committee for the August 1974 AAEA meetings in which are presented several ideas for improvement of our data systems and the conceptual base of agricultural statistics.

The Task Force on Social and Economic Statistics, chaired by George Tolley, has continued to work on the development of position papers in several basic areas of social and economic statistical needs. The areas under current examination include social and economic statistics for substate regions (Ray Vlasin), local economic development (Clark Edwards), low income problems and policy (Lee Bawden), rural area public policy (Lynn Daft), leisure and the rising value of time (Keith Bryant), and human resources (Bruce Gardner). The Task Force met June 7–8, 1973, and again on December 14, 1973, in Washington, D. C., for the purpose of developing and seminaring these papers. If intellectual development proceeds sufficiently, it may be possible to organize a session on social and economic statistics for rural areas for the August 1975 meetings of the AAEA.

Over the year, in seminars, presentations and consulting, individual members of the Economic Statistics Committee have been actively communicating the nature of the data problem to other economists and economic groups as well as statisticians and statistical organizations. The Committee's definition of the data problem presented in our 1972 progress report on "Our Obsolete Data Systems" (*AJAE* December 1972) continues to lead a life of its own, having been reprinted most recently in the *OECD Agricultural Review* (Vol. 20, No. 2, 1973). It also should be pointed out that two rather important books have been published in this area of interest. Edgar S. Dunn, Jr., a member of the Task Force on Social and Economic Statistics, has written a very significant volume, *Social Information Processing and Statistical Systems: Change and Reform,* published in July 1974 by Wiley-Interscience. Nowhere will you find as clear a view of the systemic nature and dynamics of the statistical problems we face in economic and social statistics of all types. Another volume of major interest is Karl A. Fox's *Social Indicators and Social Theory: Elements of an Operational System* published by Wiley-Interscience in December 1974. Fox attempts a synthesis of the social science theoretic base of social indicators. He makes extremely clear what many economists seem not to understand, the intimate interdependence not only between theory and analysis but also between theory and the quantitative measures which make analysis possible.

Joint ASA-AAEA Committee on Agricultural Statistics

The Joint ASA-AAEA Committee on Agricultural Statistics, which is advisory to the Census and to the USDA, met last in June 1973. At that time Fred C. Leone, Executive Director of the American Statistics Association, shared with the Committee his idea for an internship program in agriculture which would provide an opportunity for graduate students and new Ph.D.'s in statistics to get early in their academic career some practical experience to add to their usual training in statistical theory. It would also be expected to provide training for foreign students and for junior staff of statistical agencies, especially in state and municipal governments. Among other things the program would help bridge the growing gap between the theoretical statistician and the practicing statistician and develop in the theoretician some appreciation of the practical problems of statistical measurement. A draft of Dr. Leone's proposal was reviewed by the Committee before it went to the ASA Executive Committee which has approved it. If implemented as proposed, the program would be organized as the Statistical Survey Institute in the Department of Agriculture where it would be run initially as a five-year pilot program. Dr. Leone is now exploring funding sources for the pilot period.

Census Advisory Committee on Agricultural Statistics

There were two meetings of the Census Advisory Committee this past year which I attended as the AAEA representative. As previously reported, the February 1973 Census Advisory Committee meeting was a stormy session in which the Administration's failure to provide funds for the 1974 Census of Agriculture was roundly condemned by all of the major users of agricultural data. The Census Advisory Committee had not been consulted in this decision. By the time of the October 25–26, 1973, meeting of the Committee, the Senate had held hearings in May and the House in June of 1973 on a Joint Resolution instructing the Executive Branch to conduct the 1974 Census of Agriculture. Among others testifying at these hearings were six of the Census Advisory Committee including myself. Needless to say the response in the food and fiber industry to a failure to take the census of agriculture in 1974 was overwhelming. Congress saw this as another attempt by the Executive to thwart the will of Congress inasmuch as permanent legislation mandates that the census of agriculture is to be conducted every five years, and no amending legislation was ever introduced.

Following the hearings, the intent of the Joint Resolution was incorporated into the Agriculture and Consumer Protection Act of 1973, which was then enacted by Congress and signed by the President on August 10, 1973. Thus, by the time the Census Advisory Committee met in October 1973 the Administration had reversed itself, and that entire meeting was devoted to a discussion of Census plans for the 1974 census of agriculture. At the October 1973 meeting I was elected Chairman of the Census Advisory Committee, following W. E. Hamilton, also a member of the AAEA.

The Committee next met on March 27–28, 1974, in Jeffersonville, Indiana, at the Census Bureau's national processing and distribution center. Final format and plans for the 1974 Census of Agriculture were reviewed, and the Committee examined the Jeffersonville facilities. Subsequently, several Committee members including myself spent June 27, 1974, consulting with the Census on last minute major changes in printing format for the 1974 Census of Agriculture.

Also in the past year the Association approved membership in the Federal Statistics Users Conference as proposed by the Economics Statistics Committee in August 1973. We are beginning to participate in the activities of the FSUC.

Respectfully submitted,
James T. Bonnen, *Chairman*

REPORT OF THE EXTENSION AFFAIRS COMMITTEE

The Extension Affairs Committee of the American Agricultural Economics Association did not meet as a body during the past year. The business of the Committee was handled mostly by telephone and correspondence with personal discussions by the chairman with committee members during the course of other business. A meeting is planned during this annual meeting, and another meeting is to be held during the National Public Policy Education Conference which many committee members will be attending.

The activities of the Committee fall into three areas: (1) completion of the "Survey of Promotion Criteria for Economists Working in Extension," (2) areas of concern and priorities for committee work, and (3) reaffirmation of the statement setting forth the objectives or the charge to this committee.

(1) *Survey of Promotion Criteria for Economists Working in Extension*

A survey of promotion criteria for economists working in Extension was undertaken by this committee in 1973. The responses to this survey (received from 41 states) have been tabulated by region but will require a more complete analysis of the data. This analysis by region will be the first order of business for the committee. The chairman hopes to be able to present the results of this analysis to the board at the winter meetings and at the same time suggest for your reaction alternative proposals for publication and use of the results from this survey.

(2) *Areas of Concern and Priorities for Committee Work*

Committee members have expressed the following major areas of concern:

1. Completion of survey analysis
2. Review of Extension Awards Criteria
3. New innovative delivery systems
4. International aspects of Extension economics
5. Need for more articles written by economists working in Extension to be submitted to the *AJAE*
6. Continue efforts to involve economists working in Extension in annual meeting program
7. Increase membership of economists working in Extension in AAEA and in regional associations
8. Suggest economists working in Extension to serve on committees of the association
9. Concerns for difficulty of hiring Extension personnel—what can be done to encourage competent economists to accept Extension appointments
10. The appropriate role for economists working in Extension may need to be more clearly defined.

The committee has established the following priorities for the year ahead:

1. Complete analysis of survey data, present to the board, and publish results as recommended.
2. Increase the number of articles submitted to the *AJAE* by economists working in Extension.
3. Work on new and innovative delivery systems for economic information.
4. Review, with chairman of Extension awards committee, the Extension awards criteria—recommend changes if needed.

The committee will proceed in this fashion unless the board wishes to suggest other priorities.

(3) *Statement of Objectives*

The Extension Affairs Committee views its role to be that of stimulating active involvement of economists working in Extension in the affairs of the association.

More specifically, this would involve (1) suggesting ways in which the *Journal* would be more useful to economists working in Extension, (2) encouraging increased participation, of economists working in Extension, in programs of the annual meeting (we do not recommend separate Extension sections in the program but rather Extension participation in all programs), (3) creating a vehicle which will enable communications of new and innovative delivery systems, and (4) providing for improved communications of research needs to economists working in Extension.

We would appreciate your reaction to this view.

Respectfully submitted:
Charles Beer, *Chairman*

REPORT OF THE INDUSTRY COMMITTEE

The Industry Committee Chairman worked with the Chairman of the International Committee to arrange for the speaker for the Industry-International Dinner at the annual meeting.

Suggestions for activities of the Industry Committee for the coming year, include:

1. Develop a roster of professional economists and agricultural marketing specialists working in industry—both AAEA members and nonmembers as well.
2. Attempt to include one industry representative as a major speaker in a general session of the AAEA annual meeting.
3. Place greater emphasis on use of industry representatives as discussants of papers presented by academic and government representatives of the AAEA.
4. Work closely with the Agricultural Marketing Association in sponsoring their Annual Agri-Business Conference—working towards eventual joint sponsorship of this event.
5. In future years, make early contact with the AAEA program committee to assist in every way in getting industry input into the program formation.
6. Continue to work with International Committee to sponsor I-I dinner at annual meeting.

R. E. Seltzer, *Chairman*

REPORT OF THE INTERNATIONAL COMMITTEE

A year ago the committee recommended that the Association conduct a "Review of U. S. Training Related to the Economics of Agriculture of Developing Countries." This recommendation was approved by the executive board of the Association. The Rockefeller Foundation extended a grant of $15,000 for the conduct of the review.

At the suggestion of the executive board, the review has been conducted by the International Committee. The review was organized around a series of papers authored by members of the Association and three seminars arranged by the Agricultural Development Council. The seminars were held at Stanford Food Research Institute, the University of Wisconsin, and USDA/IBRD in Washington, D. C., in February, March, and April 1974.

These seminars and the papers prepared for them were important inputs for the preparation of three major papers presented at the August 1974 meetings of the Association. The committee plans to prepare a report of the review during the fall of 1974 for submission to the executive board.

The committee is very appreciative of the support of the executive board and the contributions to the review made by Association members living and working throughout the world.

During the year the committee continued strong linkages to the activities of the Research Training Network conducted by the Agricultural Development Council. Committee members have participated in many of the seminars carried out as part of this program and arranged for a small group of members of the Association to review the RTN/ADC program. AID finances the RTN/ADC and requested the review.

The committee continued to press for a decision by AID to consider non-AID people for appointments to FAO Expert Associate Programs. This effort has not yet been successful.

Respectfully submitted,
Lyle P. Schertz, *Chairman*

REPORT OF THE MEMBERSHIP COMMITTEE

As John Redman has reported, both regular and junior memberships in AAEA have increased in recent months. Credit for this improvement should be attributed to (1) the excellent job done by the membership representatives; (2) the equally excellent job done by John Redman; and (3) the joint efforts of AAEA, WAEA, SAEA, and NAEC in promoting membership in the national and regional associations.

During the past year we repeated the procedure of asking university, college, and Government Agency Administrators to designate membership representatives whose responsibility would be to advertise AAEA and invite their colleagues to join their professional organization. This year we also asked that the membership representatives promote membership in the appropriate regional associations. We received excellent cooperation and had responses from most of the institutions. I have had feedback to indicate that many of the membership representatives have done an outstanding job. Several also corresponded with me to share ideas for promoting AAEA membership. The Association owes these representatives a vote of thanks for a job well done.

The heaviest burden for promoting membership in AAEA falls on John Redman, and he has done his usual outstanding job. John has put considerable effort into following up on delinquent members. He has continued the policy of contacting each delinquent member at least five times before they are dropped from the rolls. This persistent effort continues to pay off.

Late in the year there was instituted a joint membership promotion effort with the regional associations which hopefully will have an even greater positive impact on membership in the coming year. President Tefertiller took the initiative in working out arrangements with the regional associations whereby the Vice Presidents of WAEA, SAEA, and NAEC were automatically also members of the AAEA Membership Committee. This new arrangement was explained to the AAEA membership representatives who were asked to stress the complementarity of the regional and national associations and to promote membership in both. The regional associations have responded favorably. During the past six months I have met with representatives of all the regional associations, and they expressed a desire to continue the present arrangement.

Several people have expressed the desirability of having an informative but inexpensive brochure to assist in membership recruiting. The brochure would point out the functions of the association and the advantages of membership and would include an application form. I plan to explore the possible cost and benefits of such a brochure.

Respectfully submitted,
John E. Lee, Jr., *Chairman*

REPORT OF THE INSTITUTIONAL MEMBERSHIP COMMITTEE

This committee has not been very active in recent years and this year was no exception. Primary activity consisted of sending a letter to present and immediate past years Institutional members. At this time there are 18 Institutional members. There are five that have been contacted but from which replies have not been received.

As I attempted to recruit new and old members for the committee, I discovered a lack of interest in participation unless changes could be made in purposes to which Institutional membership monies are dedicated. There seemed to be a general feeling that in the past Institutional memberships were regarded pretty much as a gift to the AAEA. It was pointed out rather forcibly to me that nearly all corporations and institutions have screened their corporate giving very closely in recent years. Only those gifts have been retained which show direct benefit to the corporation or institution. There seems to be a common feeling that even though the Institutional membership money was used for worthy purposes, it did not show enough benefit to the donors to warrant continuation of the gifts.

I promised the committee members that before I would ask them to get active in recruiting Institutional members, I would attempt to get the AAEA to change the utilization of the Institutional membership monies to purposes that might be more appealing to corporate givers. I asked President Tefertiller to bring up this question with the executive committee. I have also discussed the question with John Redman.

There are a couple of ways in which this problem might be approached. One would be for the Institutional membership committee to indicate alternate programs which they feel might attract institutional support. The other would be for the executive committee to indicate areas of activity which they feel are important to the association and which they feel might attract industry support. The Institutional committee could then decide which of the suggested areas of activity appeared to be ones which they could support and ones which would likely attract more widespread support from institutions or organizations.

I would like to recommend that the executive committee develop a list of possible AAEA programs that might be financed in whole or in part with Institutional contributions or memberships, keeping in mind the fact that programs should be of direct value to such members. Such a list could then be considered by the Institutional committee in coming up with a recommended program that could perhaps engender greater institutional support for the AAEA.

Dale Butz, *Chairman*

REPORT OF THE EMPLOYMENT REGISTRY COMMITTEE

1. The major effort of the Employment Committee during the past year has been in supervising the development and operation of the National Employment Registry for Agricultural Economists. The Registry has been in full operation since July 1 and is operated in cooperation with the Illinois State Employment Service. Joseph Ackerman is director of the Registry and Joseph Abruzino is serving as Placement Officer. Computer programming was done at Michigan State University under the supervision of Stephen Harsh. The Committee extends its thanks to Steve and to the Michigan State staff for their support and assistance.

2. Employment services will be provided at the annual meeting in cooperation with the Texas A&M Employment Committee, chaired by Carl Shaffer, and the Texas Employment Commission. The services offered will be comparable to those of recent years except that more specialized information will be available to employers and job applicants due to the flexibility of a computer-based system. Employers who listed their job vacancies with the Registry by July 26 have obtained computer printouts of candidates matching their job description.

3. As of August 2, 1196 persons have registered. (Tables presented to the executive board provide a distribution of the registrants by degree held, years experience, and subject matter areas.) In addition, 148 jobs are listed with the Registry representing 139 employers. Registration by professional agricultural economists is lower than originally intended, given the objectives of the experimental project. Many persons apparently do not understand that one does not need to be actively seeking a long-term assignment in order to be served by the Registry. Further communication with association membership will be forthcoming on this matter during the fall.

4. Registration to date has been largely from persons holding the M.S. and Ph.D. degrees. Beginning this fall, contacts will be made with graduating seniors to encourage their registration. Joseph Ackerman will be devoting most of his time during the fall in contacting employers of B.S. students to advise them of service from the Registry.

5. Several demonstration sessions are planned during the Texas meeting to acquaint employers, in particular, with the operation and use of the system in obtaining names of candidates matching job specifications. Since the computer data file is in Chicago, some long distance charges will be incurred. The Committee recommends the Association pay for the first $250 as part of the Employment Committee's annual meeting expense.

6. The development stage was more time consuming than anticipated. This will leave less time than originally planned for the operation and evaluation phases of the project. We recommend the Board authorize the Association president to submit a proposal for a project extension. Estimated length and cost (to the Manpower Administration) will be determined during the fall.

Loys Mather, *Chairman, Employment Registry Committee*
Joseph Ackerman, *Director of Registry*

REPORT OF THE RESIDENT INSTRUCTION COMMITTEE

During the 1972 AAEA meetings at Gainesville, Florida, the Board of Directors adopted a special resolution establishing ". . . a special committee . . . to evaluate student activities of the Association; that this committee be concerned not only with the existing student affairs activities but also with potential programs and with the role of undergraduate professional education."

The special committee reported at the 1973 AAEA meetings in Edmonton, and among several recommendations was the following:

> The special committee recommends that the Executive Committee of AAEA establish a resident instruction committee as a standing committee to replace both the student activities committee and the education committee.

The recommendation was accepted and the Resident Instruction Committee was organized subsequent to the 1973 meetings.

In light of developments at the 1973 meetings and giving consideration to the report of the special committee, President Tefertiller charged the Resident Instruction Committee with three major responsibilities for the 1973–74 year. The three charges and a brief response to each follow:

1. *To plan, organize, and conduct the undergraduate student activities at the 1974 meetings consistent with procedures of past years.*

In their report at the 1973 meetings, the special committee recommended that student activities of AAEA (debates, public speaking, and essays) continue through the 1974 meetings but that these activities not be continued after 1974 unless the Resident Instruction Committee determined there is an expressed need and well-defined role of such activities in the future. Consistent with this charge, the committee has organized and will conduct established student activities at the 1974 meetings. (See Appendix A for a more detailed accounting of the undergraduate student activities, and budget request for 1975.)

2. *To assist the President in planning, organizing, and conducting a session dealing with pertinent issues and/or themes in resident instruction at the 1974 meetings.* A session has been planned around the theme "Interfacing the Classroom and the World of Work."
3. *To prepare recommendations with regard to the proper and practical role of AAEA in the general area of resident instruction and issues relating to resident instruction.* Recommendations relating to this charge are to follow in this report. The list of recommendations is not considered to be exhaustive. Specific committee duties, as outlined in the report of the special committee which prompted the origination of the Resident Instruction Committee, includes the making of such recommendations on a continuing basis as the need arises.

A Base for Recommendations

The committee recognizes the importance of the third charge described above and accepts that responsibility accordingly. Clearly, recommendations on the role the AAEA should adopt in the general area of resident instruction subsumes consideration of the more specific activities referred to in charges 1 and 2. Therefore, much of the committee's thought and deliberations were directed toward this area of responsibility.

On April 29, 1974, all Land Grant and other major colleges and universities with Agricultural Economics programs and/or possible interests in the resident instruction dimension of AAEA were contacted by letter. Letters were also sent to division leaders in ERS. Reactions to the role of AAEA in the area of resident instruction in general, and undergraduate student activities in particular, were solicited. Responses were received from 20 universities and two ERS division leaders. However, many more individuals addressed themselves to the issues under consideration. A number of the responses represented the combined thoughts of either groups or appropriate committees within the departments. Given this feedback, the perceptions of committee members, and the understanding gained through interaction with colleagues, the committee feels an appropriate and adequate base of insight does exist.

Specific Recommendations on AAEA Role in Resident Instruction

Specific recommendations of the committee are as follows:

1. *The undergraduate students contests (debate, public speaking, and essay) should be discontinued after the 1974 meetings. These contests and contest-related activities should be replaced with activities and/or programs which facilitate involvement of undergraduate students as an integral part of on-going Association activities in the general area of resident instruction.*

   The committee perceives a widespread conviction that undergraduate activities of the type to be conducted at the 1974 meetings should cease. There is, however, a broad if less clearly defined conviction that undergraduate students should be involved in Association activities in general and in annual meetings, the *Journal*, etc., in particular. Many feel that students, both graduate and undergraduate, should be more fully integrated into Association activities.
2. *The Resident Instruction Committee should be charged with the task of planning undergraduate student activities and/or programs which provide for a more meaningful and broader base of interaction between students and instruction-related dimensions of the Association. These programs should be offered to the AAEA Executive Committee or other appropriate forum for action as soon as possible.*

   The committee believes undergraduate student participation in Association activities is important. The thrust, therefore, is to replace current programs with more viable and more productive programs starting with the 1975 annual meetings. The charge for developing such programs is perceived as falling within the responsibilities of the Resident Instruction Committee.
3. *A session dealing with pertinent issues and topics in the area of resident instruction should become a continuing part of the program of the annual meetings of the Association. The session should be planned by the President with the advice and assistance of the Resident Instruction Committee and should be chaired by a member of the Resident Instruction Committee.*

   There is widespread support for increased and continuing consideration of topics related to resident instruction at the annual meetings. Although other alternatives are posed by some in the profession, a session at the meetings receives the broadest mention and support.
4. *A "Teacher's Corner" should be incorporated into the format of an appropriate issue of the*

> Journal *to provide an explicit forum for papers dealing with instruction and related issues.*
>
> *Journal* publication of papers dealing with topics relating to instruction—whether resident instruction, extension activities, continuing education, or curriculum—has been sporadic at best. Many in the profession feel, rightly or wrongly, that papers dealing with instructional issues are not welcome and would have little or no chance of acceptance. Creation of a "Corner" in one issue of the *Journal* would help to correct this situation. The February issue appears appropriate given its accessibility to the professional who has something to say at the end of the year's teaching efforts. Alternatively, the particular issue which is to include the Teacher's Corner could be determined by the Editor in consultation with the Resident Instruction Committee.

The thrust of the recommendations is consistent with the major recommendations of the *Ad Hoc* Committee to shift the emphasis from student-centered to teacher-centered activities. In making this shift it is important to avoid such a drastic shift that the student is forgotten. Our recommendations are intended to provide balance—a teacher-centered activity that also recognizes the need to involve students in such a way that they will become future AAEA members.

Respectfully submitted,
Wayne Purcell, *Chairman*

APPENDIX A

Report of Undergraduate Student Activities at the 1974 AAEA Meetings

As of July 31, 1974, the status of undergraduate competition at the 1974 meetings was as follows:

1. Number schools indicating intent to participate:

Debate	11
Oratory	16
Essay	7

2. Number of students indicating intent to participate:

Debate	22
Oratory	40
Essay	8

3. Financial report and budget request:

	Approved (1974)	Request (1975)
Cash Awards	$600.00	$600.00
Judges Honorariums	300.00	300.00
Newsletter	150.00	150.00
Plaques, Keys, Engraving	90.00	100.00
Printing and Misc.	20.00	25.00
Total	$1,160.00	$1,175.00

REPORT OF VISITING LECTURER COMMITTEE

The program is limited to those universities offering an undergraduate or master's degree, but not a Ph.D. degree. Association funds are not available for the program and the Schools have few funds available to support the program. Attempts are made to match the desire for a particular individual to give a lecture and the availability of that person to travel to the college or university.

A total of four institutions indicated a desire for visiting lecturers. When requests for specific individuals were made, the committee contacted the individuals. Our records show that the following university was provided with a lecturer.

University	*Lecturer*
North Carolina Agricultural and Technical State University	Leo Polopolus, University of Florida

The number of institutions requesting lectures has declined, and the number of lecturers given has declined from ten since the first year, 1970–71. It appears a reappraisal of the program by the committee next year would be useful. Recommendations for revitalization or termination should be made to the Board in 1975.

It appears the Association owes a deep debt of gratitude to the lecturer who went to considerable personal difficulty to give his lecture.

R. J. Hildreth, *Chairman*

REPORT OF THE BIBLIOGRAPHICAL COMMITTEE

This report is a position paper regarding the financing of the *American Bibliography of Agricultural Economics* and the development and maintenance of a retrospective search system.

Historical Background

Background information is abstracted from the report to the Board of Directors of the American Agricultural Economics Association by the Literature Review Committee, Fred H. Abel, Chairman, August 1969. For over 14 years the Association has been concerned with the literature retrieval problem in the field. In the 1960 winter meetings the Association agreed to co-sponsor (with the Social Science Research Council) a conference to discuss the literature retrieval problem. Dr. Harry Trelogan organized the conference in the spring of 1961. The conference was attended by eleven librarians and eight agricultural economists. They recommended that the Association appoint a committee to design and obtain funds for a study of bibliography control of the agricultural economics literature and the bibliographic needs of agricultural economists. It was emphasized that the final product might be the creation of a special tool—the Bibliography of

Agricultural Economics. President Nicholls, in the summer of 1961, appointed the committee that had been recommended by the conference with Dr. Trelogan as chairman. The committee prepared a proposal which was submitted to NSF in July 1962 which rejected the proposal some two years later.

The Association together with ERS and SRS financed an abbreviated study (1964–1968) conducted by I. T. Littleton. Littleton presented some of his findings at the 1967 annual meetings. (See his paper in the preceedings issue. For more complete information see "The Literature of Agricultural Economics: Its Bibliographical Organization and Use," North Carolina State University, Tech. Bulletin 191.) The Board of Directors of the Association voted to enlarge the Literature Retrieval Committee and to provide it with up to $4,000 to finance a joint workshop with the NAL to consider subject categories, the NAL vocabulary, and other aspects of library services. This workshop, held in January 1968, in some sense marked a turning point for the Literature Retrieval Committee. In this workshop there was a final confrontation (at least to this moment) of the forces demanding a hierarchial scheme of categorizations of the literature and those supporting a simple categorization scheme and key word descriptors which by the use of a computer would allow a systematic search of the literature. Beliefs were strongly held and some of the supporters of the hierarchial scheme of categorization resigned from the Literature Retrieval Committee. In June 1969 the Association adopted the earlier recommendation by Dr. Littleton to set up a specialized information center in cooperation with the NAL. The purposes of the Agricultural Economics Documentation Center were to be:

a. to acquire agricultural economics literature written by U. S. and Canadian agricultural economists and other important related literature;
b. prepare the bibliographic data, copy abstract (if contained in original document), and index (assign keywords) for acquired documents;
c. have the prepared information transferred to computer tape;
d. make computer tape available to AAEA and other interested parties every two months;
e. maintain a master tape with accumulated data from the bi-monthly tapes; and
f. perform computer searches on request and at cost.

The Association was to assume the responsibility of utilizing the data tape (c. above) to publish an announcement journal, the *American Bibliography of Agricultural Economics*. Publication of the *ABAE* began in 1971 and continues to this date.

Current Situation

The literature retrieval process in Agricultural Economics is again at a crucial crossroad. The Documentation Center is established. The Bibliography is being published. A computerized retrospective search system is available from Lockheed Corporation through the NAL. The effectiveness of the retrospective search system was demonstrated at the 1973 winter meetings. In brief, the structure is complete except for financial support of the system. There are, of course, operational problems—the need for more complete cooperation of research and extension organizations to give greater coverage of the literature, increasing the rate of flow of documents through the system, the disproportionate share of costs of the system borne by the USDA, the lack of familiarity with the system by research and extension personnel, the need for a greater proportion of abstracts and better indexing, and the need to publish the vocabulary so that authors' suggestions for indexing can be improved and so that users of the retrospective search system can make more efficient searches. But the major structural problem is one of financial support.

In brief, the *ABAE* publishing costs are about $8,000 per year. The Association receives about $3,000 per year from voluntary subscriptions. The difference represents a continual drain on the Association's resources and the drain is likely to increase as publishing costs increase and as the number of documents passing through the system increase. The experience of other organizations, e.g., WAERSA and AEA, is that voluntary subscriptions will not support a bibliographical service. Our own experience with the *ABAE* supports this judgment.

Some Alternative Methods of Financing the *ABAE*

In August of 1972, the Board of Directors received a report from the AAEA Editorial Committee, Leo Polopolus, Chairman, on alternative methods of financing the increased *Journal* publication costs. Some of the alternatives considered in that report are applicable here. (See page 10 of that report dated July 31, 1972.)

(1) Mandatory page charges (on the *Journal*)
(2) Voluntary page charges (on the *Journal*)
(3) Dues increase
(4) —
(5) —
(6) No change

Other possibilities include:

(7) Discriminatory pricing for the *ABAE* (higher prices for institutional members, largely libraries)
(8) User fees on the retrospective search system sufficient to subsidize the *ABAE*
(9) "Interest-Free Loans" from all members or

sustaining members to create a capital fund, the interest earned on the fund to be used to meet annual expenditures
(10) Contributions to create a capital fund; otherwise, the same as 9 above
(11) Citation charge for each document entered in the system
(12) Re-location of Agricultural Economics Documentation Center to less expensive labor area.

The mandatory page charge was dismissed by the Editorial Committee on the grounds that it would discriminate between those who are able to pay and those who are not. We agree with this assessment and therefore eliminate this alternative from further consideration.

We also dismiss alternative number 8 on the grounds that it is not feasible because research organizations would always have the alternative of direct billing from Lockheed Corporation, thus eliminating the opportunity for an added charge.

Next, we eliminated alternative 11 on the grounds that at present we are not getting a sufficient proportion of the total literature and that the citation charge would tend to decrease the proportion received.

Finally, we eliminated alternative 12 on the grounds that close proximity to the NAL was a desirable feature and that training of new personnel would not only be disruptive but consume much of the potential savings.

This leaves alternatives numbered 2, 3, 6, 7, 9, and 10 above. To reach a choice among alternatives, we considered such factors as (1) the incidence of costs and benefits of the entire retrieval-announcement system (the *ABAE* and the computerized retrospective of the literature data file); (2) the acceptability of the alternatives to the membership and the officials of the Association; and (3) the need to get firm financing behind the system if it is to become a more or less permanent service to Association membership.

With respect to the incidence of costs and benefits, it is clear that the costs of the *ABAE* will be borne by the individual members of the Association under alternatives 3 and 6. The incidence of benefits will, however, be distributed among primary beneficiaries (users), i.e., individual researchers and their research organizations and secondary beneficiaries (clientele groups and the society at large). It seems reasonable to assume that the proportion of benefits received by the individual researchers will be much less than the proportion of the costs borne by the researchers under alternatives 3 and 6 above. Further, with respect to criteria 2 above, it is doubtful that the alternative of raising dues will be acceptable to either the membership or the officials of the Association. Alternative 6, continuing as we are, does not satisfy either the proportionality of costs and benefits criteria or the need to get some permanency of financing behind the system. Thus, we conclude that alternatives 3 and 6 are not desirable.

Alternative 7, discriminatory pricing of the Bibliography, is on the surface very enticing. The costs most likely would not be borne either directly or indirectly by our departmental or experiment station budgets Two difficulties arise, however, (1) with about 200 libraries subscribing, the rate would have to be in the $40 to $50 per year range and the elasticity of demand would be expected to be something other than zero; and (2) leakages could easily develop by having individuals within the libraries subscribe to the *ABAE* at the $10 rate.

Alternatives 9 and 10 (creation of a capital fund via contributions or interest-free loans to the user) were eliminated on the grounds that at least in the immediate future the probability of the creation of such a fund is so low as not to meet the criterion of firm financing behind the system.

Finally, we come to the voluntary page charge for the *Journal* alternative. First, our support of the voluntary page charge rests on the premise that the information system (both announcement and retrieval aspects) is an integral part of an efficient research organization, analogous to computer and library services which are normally provided by the research organizations. The page charge is a mechanism (albeit not a perfect one), by which the various organizations can contribute their financial support for the provision of the service.

Second, it is our belief that while both the individual and the organization of which he is a part are primary beneficiaries, the organization is the principal primary beneficiary. Currently, however, the costs of the *ABAE* are borne almost totally by the individual either directly (as a subscriber) or indirectly through the payment of dues to the AAEA. The Economic Research Service provides the major organizational support for the entire informational system in the form of Isabelle Jenkins, Director of the Agricultural Economics Documentation Service, and indexers at the Branch and Division level. Other organizational support is largely limited to cooperators who periodically collect and mail documents to the Center. The organizational support provided by the State Experiment Stations and Extension Services is clearly not in proportion to the relative number of potential users (relative to ERS) or the relative share of potential benefits.

A number of journals published by associations to which agriculture faculty belong already have voluntary page charges. This list does not purport to be complete. Yield estimates (receipts/expected receipts) were obtained from editors or executive secretaries of the associations.

Soil Science	First 4 pages free; $90 per additional page; yield is 99 percent
Agronomy	First 4 pages free; $90 per

	additional page; yield is 99 percent
Crop Science	$20 per page for first 4 pages; $90 per additional page; yield is 99 percent
Transactions (Agr. Eng.)	$100 per page; yield is 95 percent
Journal of Heredity	$50 per page; yield is 90–95 percent
Dairy Science	$30 per page; yield is 80 percent (was 95 percent)
Animal Science	Reprint and page charge combined, $30 per page; 80 percent yield
Biology of Reproduction	$20 per page; 50 percent yield (most work financed by grants)
Weed Science	$45 per page; 90 percent yield

Some other associations that do not utilize page charges on their journals are listed below together with their dues.

American Society for Horticultural Science publishes two journals, *Horticultural Science* and *Journal of American Society for Horticultural Science;* $35 per year with $5 per year increases for the next 3 years.

Poultry Science	$25
Agricultural Engineering	$20–$40 based on age of member

Please note also that the journals for Biochemistry and Bacteriology have recently discontinued page charges as their yield was only about 25 percent.

Finally, any expansion in the number of documents entering the Center may place so much pressure on the indexers that the services of outside supplemental indexers may need to be purchased. This emphasizes the need for firm financial support of the entire system.

It is for the preceding reasons that we recommend the adoption of a voluntary page charge for the *Journal* with specific exemption of the USDA from these page charges in return for the USDA contribution as shown in the budgetary materials (presented to the Executive Board). It is assumed, however, that if at any point USDA page charges exceed their contributions, the USDA, like all other institutions, will be subject to page charges.

Other preferences of this committee in order of preference are:

1. Dues increase to generate approximately $20,000 of income.
2. Some combination of dues increase and page charges which will generate approximately $20,000 of income.
3. Any of above plus substitution of "Publications Received" section in *Journal* without descriptors and abstracts for the current *ABAE*. This would be instituted sometime during the next three year period with one year notification.
4. Close down entire system.

In addition, the committee recommends that a new cooperative agreement be worked out between the National Agricultural Library, ERS, SRS, and the AAEA which will (1) permit access to the Lockheed Retrospective Search System through NAL and (2) increase the AAEA contribution to the Documentation Center to the extent of providing a computer terminal and a control clerk.

LEE M. DAY, *Chairman*
KEN FARRELL

REPORT OF THE *AJAE* EVALUATION COMMITTEE

Charge to the Committee

At Gainesville the AAEA Executive Board passed the following motion (October 25, 1972):

> Wallace reported for an ad hoc committee on the role of the Journal and its problems. The committee noted that the purpose of the AAEA Journal is broadly to present research findings, professional experiences, reviews, observations and news pertinent to those in the profession. Rising printing costs, increased number and quality of Journal submissions, and a diverse membership call for a review of the role and operational "format" (article length, content, Proceedings papers-discussions, association business reporting, i.e., the entire scope, content, authors, readers and users of the present Journal). Wallace moved that a committee knowledgeable about the Journal be appointed by the President to make such a review for the Executive Board of the AAEA in the next year.

Committee Procedure

The committee assignment was completed for the most part via correspondence. A detailed assessment of the charge was requested from each committee member, the current editor, and three past editors. Each committee member and editor took the assignment seriously and submitted extended, seriously considered letters. This correspondence has been very helpful and will be turned over to the President. The Editor should also have an opportunity to read it.

Each department of agricultural economics, the USDA, and business members were asked to hold a seminar on the charge of the committee. This procedure was followed because we wanted member sentiment to emerge from the discussion of small groups rather than from individual questionnaires. Almost all departments submitted reports which were exceedingly insightful. The committee, again, extends its appreciation to the department faculties and others for their cooperation and assistance. With this background, the committee held a seminar in Washington, D. C., June 21, 1974.

Our recommendations are divided into two parts: (a) those which are pertinent for consideration of the editor and the editorial council; and (b) issues dealing with the Association's publication policy. This distinction is important as the editorial council and the editor can immediately institute changes within their existing framework of authority. Other issues, however, deal with the Association's charge to the editor. But in both instances, the Evaluation Committee wanted the point to be clear that the editor should have a "free editorship" within the general guides of the Association and Council. The "free editorship" is important to the maintenance of a *Journal* of the highest quality.

Committee Report

Members of the Association value the publication of the *Journal* as the most important product from belonging to the Association. They want the quality of the *Journal* to remain high. One of the prime roles which it now fulfills is to provide an outlet for disseminating advances in research methodology and a limited selection of applied research results. The articles are used primarily by academic members in their own research as well as in graduate student education. Departments with substantial graduate programs frequently commented on the utility of the *Journal* for this purpose.

This utility and esteem, however, should not delude us into believing that the *Journal* as presently constituted is meeting all of the demands of members for Association publication. Widespread, severe, but constructive criticism is frequently leveled at the *Journal,* but usually with a caution—go slow in making changes, so that its present value will not be lost. These criticisms may be summarized:

(1) The articles are so highly mathematical for my needs, I do not read the articles.

(2) I want to read analyses dealing with "substantive" problems about private or public policy issues instead of so many articles emphasizing methodology and the application of techniques.

(3) The range of problems analyzed is too narrow. My work is in fields not dealt with in *Journal* articles.

(4) The number of agricultural economists has grown rapidly yet the Association has not broadened its publication service to members. With a 60 to 70 percent rejection rate many good articles must be bypassed. Members are penalized by not having an adequate publication outlet. On the one hand, other individuals say only 30 to 40 percent of the manuscripts submitted are published and yet they are disappointed with the quality and significance of those which are published.

(5) We do not have an opportunity to read articles by the older, mature, members of the profession. Articles reflecting mature judgment dealing with the analysis of policy are not to be found in the *Journal.* But space for data and mathematical symbols is plentiful. The conclusions of the latter type of article can frequently be stated in a very short space and are "obvious." The articles are not addressing the significant economic issues of the day.

(6) *Journal* operations seem quite remote from many members. The procedure of selecting the editor is generally unknown! Several felt the members should have a direct voice in the selection process with a few suggesting the editor should be elected every four or five years. The policies of the *Journal* were often unknown—how articles are reviewed, criteria which the reviewers should follow, the extent of anonymity, etc. Because of the lack of awareness among a broad spectrum of members about *Journal* policy, the editor should develop better communication with members.

A. Recommendations for the Editor and the Editorial Council

1. The editors should be careful that the mathematics used in articles is essential to the logical content of the article and that the reader can comprehend the article from the literary exposition. The abstracts are very useful. At times, they might be a little longer to communicate better, in a non-mathematical form, with a larger audience. This policy would force authors to evaluate the logical necessity of the mathematics, to develop communications skills in literary style, and to broaden the basis for understanding and applying the results of their work
2. For all subject matter with a policy relevance, the editors should insist that authors deal with the policy implications of their work. The policy content should be clearly and explicitly stated. The frequently used phrases, e.g., "it may be useful," "it is obvious," or "that many people are interested in" are no substitute for the author's policy assessment.
3. The Editorial Council, and/or the Editor, should consider commissioning thorough, analytical, articles reviewing the current "state of the art" for well defined subjects of broad interest. Examples of such articles in other journals are (a) Turvey and Prest, "Cost Benefit Analysis: A Survey," *Economic Journal,* 75, (1965), pp. 623–735; and (b) Furabotin, Eirik G., and Pejovich, Svetczar, "Property Rights and Economic Theory: A Survey of Recent Literature," *Journal of Economic Literature,* Vol. X, No. 4, Dec. 1972, pp. 1137–1162. Many members would welcome one or two such articles a year.

4. The mechanics of *Journal* operation should be written and communicated to all members.

   We realize the manpower and financial problems of the University and the Association connected with the editorship and that many questions must be negotiated with the University Administration. However, the whole process of selecting the editor and other editors should be more open to suggestion from the members. Possibly some of the Editorial Council should be elected.

   A statement about the *Journal* might be enclosed in the *Journal* for distribution on an annual basis. Also, the dates of the editor's term could be included on the cover page.

   Members should be familiar with the reviewers' checksheet as well as the whole review process. Particularly, anyone sending in an article should have complete information as to how his article will be handled.
5. High quality articles dealing with the analysis of problems, ideas, and issues in a literary style should continue to be given full consideration. Such articles have appeared recently in the *Journal* and the image that they are unacceptable should be overcome.
6. Many commented upon the review process, in particular, whether the reviewers should know the name of the authors and vice versa. The committee discussed this issue in detail and concluded that articles should be circulated to reviewers with the author's name omitted. Reviewers should have the option of signing or not signing their reviews. However, we wish to emphasize that reviewers should generally be willing to have their names attached to the review. Signing reviews encourages reviewers to take responsibility for what they say and not hide behind anonymity.
7. The editor should encourage authors to have their manuscripts critically reviewed by their colleagues prior to submission. This practice, although widely followed, should reduce the editor's work load and speed up the handling of manuscripts. Acknowledgment of such reviews by the author should continue to be the general rule.

B. Recommendations for the Association's Publication Policy

A number of complex questions focus upon the Association's overall publication policy rather than upon issues to be dealt with by the editors. To preface the committee recommendations, some of the views which are held by a wide spectrum of members will be summarized.

1. As reflected in our professional publications, we do not analyze questions dealing with the most significant areas of direct policy significance. On a world, national, and regional basis, agricultural (including food, population, and consumer), resource management, community development, market structure, economic organization, etc. issues are among society's most critical problems. Yet our professional thinking as expressed in the *Journal* does not regularly grapple with these issues. The Association should reassess the statement defining the areas of academic interest to reflect the broad professional interests of its members.
2. Too much emphasis is placed upon the publication of articles derived from theses. The fact that graduate students do much of the research is acknowledged and is significant to the whole process of *Journal* publication. In a subtle way, this fact has helped establish standards for accepting articles by influencing the mathematical or empirical requirements. The image of "necessary" methodological or mathematical content of the *Journal* keeps some individuals from submitting manuscripts whether or not the image is true. This may be one reason that good "idea articles" with a strong scholarly content are infrequently submitted.
3. Other professions have a wider spectrum of outlets for the results of their research. The Association should publish more pages directly or encourage other publications. During the past twenty-five years many new Ph.D.'s have been graduated. This fact broadens the potential clientele which the Association should be serving. The profession is being penalized for lack of publication space. This fact adversely affects promotion up the university's academic ranks. Also, the decline of the Experiment Station Bulletin has reduced the opportunity for publication.
4. It is difficult to keep up in all fields. The Association should have a regular process of soliciting high quality review articles which are analytically competent, with good bibliography (noted earlier).
5. Issues of interest to extension, undergraduate teaching, and industry are seldom analyzed in the *Journal.* In fact, government economists utilize the *Journal* less than might be anticipated. A focus needs to be created to serve these members. If it is adequately performed, membership might be enlarged.
6. Why are not our "bright" people using the *Journal?* This was the comment from an organization from which we solicited comments. This question was answered in the following ways.
   (a) The articles are not really of the highest quality and we see flaws in the presentations.
   (b) The articles may be technically good, but they are too narrow and not useful for

policy. They do not address the cutting edge of today's issues.

(c) The data is old by the time it is published. The current situation is changing so rapidly the articles are of little use.

This dissatisfaction with the Association's publication policy is real, and widespread. We feel, and the correspondence reflects the position, that the Association should make changes, but that the changes should be incremental so as not to destroy the quality of the existing publication.

If these problems are to be tackled, it becomes clear that there is a need for the Association to publish more pages as well as consider counsel to the editor. The following recommendations deal with Association policy.

1. Eliminate from the printed *AJAE,* all minutes of meetings, news notes, announcements, and other "soft" material of this type. Use these pages for articles. Last year about 70 pages were devoted to "soft" material. We are cognizant that members value this information and they want the Association to continue to provide it. However, this information should be sent to the members as a low production cost newsletter. Someone in the office of the secretary-treasurer might well be assigned this task with a mailing every two or three months. Other materials might also be distributed in this fashion, such as subject bibliographies, titles of new computer programs, news notes, announcements of meetings, and other timely information.

   We did not call this publication a "Chronicle" because we felt this might imply moving to a second national journal although the *Newsletter,* at some future date, may evolve into a more substantive undertaking. The Committee believes, however, that several other steps should be taken prior to seriously considering such a publication and that added space, as recommended, should be tried before considering a second national journal.

   These "soft" materials could be compiled in a numbered series as a supplement to the *Journal* so that they could be bound for library collections. Thus, there would be more permanence for the minutes of the annual meetings.

   The newsletter staff could provide added services which have been strongly recommended by many members. The following types of services should be given serious consideration.

   (a) A method for defining available computer programs should be developed. A listing and description of new programs could assist in putting members with similar interests in contact with each other.

   (b) The availability of subject matter bibliographies would be helpful. The full bibliography would not be published, just the subject, number of items cited, and individual to contact.

   (c) Course outlines could also be listed and circulated on a contact basis.

   (d) Titles and short descriptive paragraphs of extension programs could be listed. Again, interested members could contact each other.

   A few members have expressed the opinion that the deletion of the "soft" material from the *Journal* would have an adverse effect on membership. The committee, however, would take this risk and initiate a newsletter.

2. The summer and winter meetings and their proceedings should again be re-evaluated. We recommend a broader publication policy for papers than in recent years. The policy with respect to proceedings has oscillated from being very inclusive with the publication of a massive volume to a more selective volume, publishing only major papers with other papers subject to submission to the *Journal* for regular review.

   The committee recommends that the annual meetings and their proceedings are a most appropriate way to have members of the Association focus upon policy, extension, teaching, and industry problems in addition to research. Also, the present rules with respect to which papers are published should be broadened and the editorial responsibility changed.

   (a) When the annual meetings are being planned, the president and board should make a special effort to have policy analyses and debate a significant part of the programs. Past meetings have done this, but a clearer focus should be directed upon this aspect of both the summer and winter programs. The broad spectrum of member interest should continue to be given special attention, including subject areas as resource economics, community analysis, regional economics, marketing, political science analysis, social trends, institutional analysis, etc. as well as policy, research, teaching, and extension in agricultural economics, narrowly defined.

   (b) More papers presented at the annual meetings should be published. All invited papers, discussions, and section papers should be published. Abstracts of contributed papers should also be published with the possibility of the editor selecting from each group one or two of the best papers for full publication.

   (c) Because of the heavy editorial burden of the *Journal* editor, the proceedings issue should have a special editor. This editor should have the power to return manuscripts to authors for additional work and clarification so that the proceedings issue will be of high quality. Also, he may reject a paper with the concurrent judgment of the editor of the *Journal*. However, we anticipate that most papers could meet the publication standards after careful revision, but there would be no absolute guarantee of publication. Because of the need for revision, the present time constraints for publishing the proceedings issue should be re-evaluated.

(d) The proceedings of the annual meetings should be published in addition to the current five issues and carry a separate charge if this is deemed necessary. The current proceedings issue should be made another issue of the *Journal*. This action would (1) open space to publish more pages and (2) give a greater opportunity to publish in areas of interest to members. This action would move to correct many of the criticisms of the present publication policy. Possibly over 200 pages could be added to the *Journal* to broaden existing publication policy.

(e) We recommend the index remain in the published *Journal* and that the publication of theses be in the published *Journal* rather than in the newsletter. The reason for the latter recommendation is that it will facilitate bibliographic research in future years. Also, the proceedings would be in the Journal series so that it will be handled by libraries. A less expensive form of printing, however, should be considered along with special funding.

3. In some areas of member interest, journals may not be the best means of communication. This may be true for some aspects of teaching, extension, and industry analysis. Special symposia should be encouraged so that the resulting publication will have a targeted, and yet widespread, benefit. The Association should consider a policy of acting as a sponsor.

   Although not previously separated as a group, we feel that the *Journal* and the Association are not as helpful to government economists as we would desire. Membership, readership, and participation are low when the total number of employees is considered. Again, the interests and needs of these economists are different than those of the academic research economists. These differences should be recognized. Symposia may offer an opportunity for providing better service. This should be discussed with USDA officials.

   Each symposium would have to develop its independent funding. The utilization of the Association name might aid in seeking financial support.

4. The question of regional journals was reviewed. The committee was not opposed to these journals; in fact, we were supportive of their objectives; and we felt the national association should constructively work with these groups and make a greater effort to integrate their interests. Present policy does not give regional groups participatory status which is conducive to good working relationships and in the long-run interests of members. This area of Association policy needs to be critically assessed in cooperation with the regional groups. Present policy is not adequate.

5. Many members are of the opinion that agricultural economists are being penalized because of lack of opportunity to publish their research. Some members hold the view that as a group we are at a promotion disadvantage *vis-à-vis* other professional groups on university faculties.

   The committee felt that the Association should not let promotion problems in universities be a guiding criteria for judging the *Journal* and the Association's publication policy. Each department has the responsibility to explain publication opportunities to its own organization and its junior faculty. Each university has its own criteria and system for evaluation. This problem is being met in a variety of ways and we encourage communication among departments on this subject. The recommended changes, however, would open more pages to publication which would be responsive to the need for greater availability of printed space.

6. The committee did not deal with the question of financing publications. We feel, however, that Association charges could be increased to reflect the service recommended. A special charge for the proceedings was favorably discussed. Our dues are low in comparison to other associations, and if we gave a broader range of service, members might increase! Given the priority that members attach to a quality *Journal*, a reallocation of resources in favor of the *Journal* or *Journal*-related activities should be considered.

Stephen C. Smith, *Chairman*

MINUTES OF THE EXECUTIVE BOARD MEETING

New York, December 26–27, 1973

The meeting was called to order by President Kenneth R. Tefertiller at 8:30 p.m., December 26, 1973.

Present:

Voting members: Tefertiller, Day, Farrell, Castle, Nielson, Robinson, Heitz
Members ex officio: Redman, Langham
Guests: None

1. Minutes of the Summer Meeting of the Executive Board at Edmonton, August 7–11, 1973, were approved as distributed.
2. A report from Travis Manning, Chairman of local arrangements committee at Edmonton,

was read, noting that with 679 paid registrants and a total attendance of 1490 the revenue exceeded expenses by $3831.13. It was proposed that the University of Alberta receive $2203.35 of the surplus and the remaining $1627.78 go to AAEA, noting that the University had made an initial grant of $5000 for this purpose. Also, it was proposed that the account be closed on April 30, 1974. Acceptance of the report was delayed until the details could be studied.

3. Redman reported for Wallace on San Diego as place for 1977 meeting. Nielson moved that the Hotel Circle in Mission Valley be reserved for July 31–August 3, 1977 meeting and because of various uncertainties the decisions relating to this meeting be reviewed again at the Summer Meeting. Seconded. Carried.
4. Day moved that the final reports of the Gainesville meeting of AAEA and the Educational Workshop at University of Florida be accepted and the accounts closed. Seconded. Carried.
5. Day reported for the ad hoc committee on balloting procedures. Farrell moved that the report be accepted and that the by-laws be amended where necessary to implement the recommendations in the report (see report elsewhere).

Recessed at 11:45 p.m.
Reconvened on December 27 at 8:30 a.m.

Present:
  Voting members: Tefertiller, Castle, Nielson, Day, Farrell, Heitz, Robinson
  Members ex officio: Redman, Langham, Polopolus

6. Polopolus reported as Editor indicating that the December issue will be mailed by mid-February and the May issue is on schedule.
7. After discussion on copyrighting the *Journal,* Day moved that the *American Journal of Agricultural Economics* be copyrighted in the name of the American Agricultural Economics Association, effective with the February 1974 issue, and to authorize the application and payment of fee with the understanding that any royalties to individual articles as a result of the copyright be remitted to the authors. Also, the legal counsel investigate the possibility of a statement specifying the conditions under which the article can be reproduced for classroom and similar uses. Seconded. Carried.
8. Nielson moved that AAEA grant the Johnson Associates the right to reproduce the *Journal* in microfiche form but as a part of the contract the sale of microfiche be restricted to the current subscribers of the *Journal.* Seconded. Carried.
9. Schertz reported for the International Committee. Farrell moved that the President consider the advisability that a session on training of economists for international work be a part of the summer meeting. Seconded. Carried.
   Nielson moved that AAEA lend its support in encouragement of training and employment of agricultural economists from U. S. for international work. Seconded. Carried.
   Nielson moved that AAEA support the U. S. participation in "Expert Program" in international work. Seconded. Carried.
10. After a discussion on the relationships of the Editor, the Editorial Council, and the Executive Board, Nielson moved that the following statement be made as a matter of policy:

    The motion made by Nielson and seconded by Day at the New York Meetings, December 1973, indicated the following:

    1. The Board shall:
       a. Elect the Editor, from nominations made by the President.
       b. Approve the criteria to be used in selecting Editorial Council members.
       c. Determine long-run policies affecting *AJAE,* including copyright and related policies.
       d. Approve the general content of special issues of *AJAE.*
       e. Select the printer.
       f. Determine the annual budget for editorial operations and *Journal* printing.
    2. Members of the Editorial Council shall be appointed by the President-Elect on recommendation by the Editor.
    3. The Editor shall:
       a. Select the other members of the editorial staff and assistants.
       b. Determine the content of each regular issue of *AJAE.*
       c. Determine the format of *AJAE.*
       d. Determine operational policies for the job.
       e. The Editor or the Associate Editor shall attend each regular meeting of the Board with the travel costs being paid by the Board.
    4. The Editorial Council shall select the paper to receive the award as outstanding *Journal* article.

Seconded Carried.
Recessed at 12:10 p.m.
Reconvened at 1:30 p.m.

Present:
  Voting members: Tefertiller, Castle, Nielson, Day, Farrell, Heitz, Robinson
  Members ex officio: Redman, Langham
  Guests McArtle, Crawford, Jenkins, Harston

11. Day reported for the Committee on *American Bibliography of Agricultural Economics.* Mc-

Artle presented the background of *ABAE* activity. Crawford presented information on using an on line computerized system for retrieval of information and then demonstrated the technique. The question evolved is whether or not the AAEA want to sponsor a retrospective search system which is a public good. The *ABAE* is a means to an end of achieving a system of retrospective search.

Day moved that AAEA amend the cooperative agreement with NAL, ERS, SRS and cooperate with NAL in providing the AAEA data base so computerized retrospective search can be made available. Seconded. Carried.

Castle moved that the subject index be eliminated effective with the February 1975 issue, and a suitable communication be placed in the *ABAE* and the *AJAE* on the use of computerized retrospective system. Seconded. Carried.

Day moved that AAEA finance the installation of a terminal in the office of Miss Jenkins at the approximate cost of $2,500 for one year. Seconded. Carried.

12. Harston reported for local arrangements for summer 1974 meetings at College Station, Texas. Castle moved that a registration fee be set at $14 for single registrants and $17 for families if the local arrangements committee deem necessary and if additional information becomes available which may affect the fee, the committee should check with the President before a final decision. Seconded. Carried.

    Nielson moved that $2,000 be advanced to Texas A&M University for handling the necessary expenses before revenue starts coming in. Seconded. Carried.

Recessed at 5:30 p.m.
Reconvened on December 28 at 8:15 a.m.

Present:
Voting members: Tefertiller, Castle, Nielson, Day, Robinson, Farrell, Heitz
Members ex officio: Redman, Langham, Polopolus
Guests: Stanton

13. Tefertiller reviewed the activities of CAST and ARI with no decision to join.
14. After a review of the contributed papers program, Farrell moved that abstracts of 50 words or less of contributed papers be published in the *AJAE*. Seconded. Carried.
15. Stanton reported for the awards committee. Day moved that AAEA approve the procedures of submitting the possibility for the Browning Award. Seconded. Carried.
16. Tefertiller and Redman reported for the Employment Committee.
17. After a brief discussion of the report on the Edmonton meeting, Castle moved that the division of funds as proposed in the report (see item 2) be accepted since the AAEA policy has always been to share in any surplus according to the risk. The account is to be closed on April 30, 1974. In the Edmonton meeting the risk was shared by both the AAEA and the University of Alberta. Seconded. Carried.
18. Tefertiller presented a report on his efforts to secure an Editor for the *AJAE*, effective with the February 1975 issue. After discussion on the possibilities and need for further information, Castle moved that the Board select the Editor by mailed ballot and a report be made at a later date. Seconded. Carried.

Adjourned at 11:30 a.m.

Respectfully submitted,
JOHN C. REDMAN
Secretary-Treasurer

MINUTES OF THE EXECUTIVE BOARD MEETING

College Station, Texas, August 17-21, 1974

The meeting was called to order by President Kenneth R. Tefertiller at 8:50 a.m., August 17, 1974.

Present:
Voting members: Tefertiller, Robinson, Baker, Heitz, Wallace, Day, Farrell, Castle, Nielson
Members ex officio: Redman, Langham
Guests: Harston, Bonnen, Tomek

1. Harston reported on local arrangements, indicating that the number of registrants was about as expected but the number of women and children was down from previous years. All arrangements were in order.
2. Baker moved that the minutes of the Winter Meeting of the Executive Board at New York be approved as distributed. Seconded. Passed.
3. Tefertiller read the Tellers Report, indicating that James T. Bonnen was elected as President-Elect and Fred A. Mangum, Jr., and B. F. Stanton were elected as Directors.
4. Nielson moved that the report on the division of the surplus funds from the Edmonton meeting be accepted with $1627.78 going to AAEA and approximately $2071.25 to the University of Alberta, and that the books be closed. Seconded. Passed.
5. Redman distributed the Secretary-Treasurer's Report and the Investment Committee Report which will be presented at the general business session of the AAEA.
6. Redman reported that the *Journal* was being copyrighted, effective with the February 1974 issue as authorized by Executive Board at its meeting on December 26, 1973.
7. Tefertiller read the report of the Auditing Committee. Baker moved the acceptance. Seconded. Carried. The Auditing Committee

requested some additional guidelines on procedures. Action was delayed until the Winter Meeting.

8. Tefertiller reported on various communications with CAST, including invitation to join. No action was taken.
9. Wallace reported for Professional Activities Committee, indicating that the apparent lack of interest was because the concern at the time of appointment has been alleviated. Wallace moved to eliminate the Committee and that *ad hoc* committees be appointed as future needs arise. Further, Wallace moved that by-laws be so amended. Seconded. Passed.
10. Wallace reported on the 1977 plans for San Diego. Baker moved that we reaffirm AAEA's intention to hold the 1977 meeting in San Diego. Seconded. Passed.
    Baker moved that we express our desire to return to the campus in 1978 and that we solicit invitations for decision at the Winter Meeting. Seconded. Passed.
11. Bonnen reported on activities of three (3) committees on statistics. No specific action was taken.
12. Farrell discussed various possibilities of a suitable memorial for G. W. Dean. Other possibilities will be pursued with the Board being kept informed.
13. Day reported on the updating of some provisions of the memorandum of understanding between AAEA and the National Agricultural Library, Statistical Reporting Service, and Economics Research Service, pointing out some relative contributions of each participant to the evolving system of retrospective search. Castle moved that AAEA finance the expenses, up to $200, for a representative to demonstrate the capability of the retrospective search system at the Annual Meeting in College Station, Texas. Seconded. Passed.
    Day presented a position paper regarding the financing of American Bibliography of Agricultural Economics and Retrospective Search System. Decision on memorandum of understanding and financing was delayed until budget was considered.
14. Day reported briefly on 1976 plans and facilities for hosting the AAEA at Pennsylvania State University.
15. Day reported for the North East Agricultural Economics Council, expressing desire to have a voting member on AAEA Board and to have two (2) or more joint sessions on AAEA programs. Ken McIntosh is the President.
16. Nielson reviewed the 1974 Winter Meeting program.
17. Day moved that AAEA not become involved in any insurance programs for members. Seconded. Passed.
18. Langham presented the Editorial Report.
19. Tomek reported briefly on plans as an incoming editor, indicating there will be no drastic changes in the *Journal* but a few will be made.

Recessed at 4:55 p.m.

Reconvened on August 18 at 8:30 a.m.

Present:

Voting members: Tefertiller, Robinson, Baker, Heitz, Wallace, Day, Farrell, Castle, Nielson

Members ex officio: Redman, Langham, Polopolus

Guests Butz, Stanton, Tomek, Smith, Purcell, Hildreth, Martin, Mather, Ackerman, Lee, Schertz, Seltzer, Beer, Boyne

20. Butz reported for the Institutional Membership Committee, pointing out the problems inherent in the program to attract institutional members. Wallace moved that a program be developed which will meet the objectives and needs of the Institutional Members. Seconded. Passed.
21. Smith reported for the *AJAE* Evaluation Committee. Wallace moved that the report be accepted and that Smith and his committee be commended for an excellent report. Seconded. Passed.
    Since several recommendations and alternatives involve costs, Wallace moved that a small committee be appointed to evaluate these and report back at the next Winter Meeting. Seconded. Day moved that the motion be tabled until certain issues are discussed and settled. Seconded. Carried.
    Castle moved that the recommendation concerning the establishment of a "newsletter" where the "soft" materials can be published rather than in the *Journal* be explored. Seconded. Passed.
    Castle moved that the recommendation pertaining to the publication of the proceedings of the summer and winter meetings be explored, paying attention to problems of coordinating two separate publications and also to the benefit and cost of alternatives. Also, all alternatives such as annual meetings, special seminars, symposia, etc., should be explored as appropriate alternatives Seconded. Passed.
    It was felt that the recommendation suggesting special symposia for improvement of communication among member groups could be handled in the previous motion.
    Farrell moved that the recommendation pertaining to regional journals, the question of lack of opportunity to publish, and the question of financing the publications, although all are important issues, receive lesser emphasis in the evaluation process of alternatives. Seconded. Passed.
    Day moved that the original motion be taken from the table. Seconded. Passed. The original motion, with the specifications attached. Passed.

22. Stanton reported for the Awards Committee. Baker moved that the report be accepted and that the new chairman be permitted to make minor changes in the announcement.
23. Purcell reported for Resident Instruction Committee. Nielson moved that the recommendation of Resident Instruction Committee to discontinue student contests after 1974 and to develop such activities or programs which will facilitate the involvement of undergraduate students as an integral part of on-going AAEA activities be accepted. Seconded. Passed.

    Nielson moved that recommendation of the Resident Instruction Committee be accepted to assign the Committee the task of planning undergraduate student activities or programs which will provide a more meaningful and broader base of interaction with AAEA and that a report on proposed activities be made at the Winter Meeting in San Francisco. Seconded. Passed.

    Day moved that the recommendation to plan a session dealing with pertinent issues and topics in resident instruction as a continuing part of the AAEA program and that the program be planned by the President with the advice and assistance of the Resident Instruction Committee be accepted. Seconded. Passed.

    No decision was made relative to the recommendation to establish a "Teacher's Corner" in the *Journal.*
24. Mather reported on the progress of the Employment Committee's activity to establish a National Employment Registry for Agricultural Economists. Farrell moved that AAEA expend up to $250 to assist in the demonstration of the employment system at the 1974 annual meeting. Seconded. Passed.
25. Hildreth reported for the Visiting Lecture Program with the recommendation that the program be reappraised and revitalized or terminated in 1975. Wallace moved the report be accepted. Seconded. Passed.
26. Lee reported for the Membership Committee indicating that results were being obtained from the efforts expended.
27. Martin reported on progress of the Literature Review, indicating that three (3) volumes were nearing a completion date. Wallace moved that the report be accepted and that Martin be complimented for his untiring efforts. Seconded. Passed.
28. Schertz reported for the International Committee.
29. Seltzer reported for the Industry Committee, recommending a roster of agricultural economists in industry be developed if feasible.
30. Beer reported for Extension Committee.
31. Boyne reported on plans for 1975 AAEA meeting at Ohio State University.
32. Wallace moved that the Day report and position paper be accepted. (see item 13) Seconded. Passed.
33. Farrell moved to approve the recommendations of Day's report on *ABAE* and Retrospective Search System (excluding the method of financing) and to reaffirm the Board's support for a system of retrospective search. Seconded. Passed.
34. Farrell moved to approve the budget with adjustments to include the financing of activities approved. Seconded. Passed.
35. Wallace moved that AAEA initiate a voluntary page charge of $40 per page on articles published in *AJAE* to finance the activities of the Association, effective with February 1975 issue, or at the earliest possible date. Seconded. Passed.

Recessed at 4:50 p.m. August 18, 1974.
Reconvened at 12:30 p.m. August 20, 1974

Present:
Voting members: Nielson, Stanton, Tefertiller, Baker, Heitz, Robinson, Farrell, Bonnen
Members ex officio: Redman, Langham
Guest: Tomek (new editor)

36. President Nielson opened the meeting.
37. Tefertiller stated that he wanted to express his personal appreciation to John Redman for his stellar performance in his role as Secretary-Treasurer and moved that it be recorded in the minutes. Seconded. Passed.
38. It was announced that the page charge of $40 will be implemented effective with the February 1975 issue. Baker moved that those who honor the page charge are to receive 100 reprints free. Seconded. Passed.
39. Heitz moved that suitable procedures be developed to collect the page charge and to communicate to the membership that the author's employer would be expected to pay the page charge but that the bill will be sent to the author. Seconded. Passed.
40. Nielson raised the question of reduced dues for retired people. No action was taken.
41. Stanton reported on a request from the Awards subcommittee on publications of enduring quality, that the time be increased to fifteen (15) years. Seconded. Passed.
42. Nielson solicited suggestions for the program for August 1975 meetings at Ohio State.

Adjourned at 2:15 p.m.

Respectfully submitted,
John C. Redman
Secretary-Treasurer

MINUTES OF THE ANNUAL BUSINESS MEETING

College Station, Texas, August 20, 1974

The 63rd Annual Meeting was called to order by President Tefertiller at 8:30 a.m.

1. President Tefertiller presented for approval the minutes of the Annual Business Meeting held in Edmonton, Alberta, August 10, 1973, as published in the proceedings issue of the *AJAE*. Motion made to accept. Seconded. Passed.
2. Tefertiller announced the results of the election.
3. Tefertiller reviewed the decisions and activities of the Board including the appointment of William Tomek as incoming editor, hearing report on evaluation of *AJAE* and establishing a page charge to finance the activities of the Association.
4. Redman presented the Secretary-Treasurer's Report on fiscal year, January 1, 1973, through December 31, 1973.
5. Redman presented the Investment Committee Report for fiscal year, January 1, 1973, through December 31, 1973.
6. Redman distributed copies of 1975 budget which had been approved by the Executive Board.
7. Langham reported as Co-Editor of *AJAE*.
8. Tefertiller announced the upcoming meeting places and dates and asked for invitations for future meetings.
9. Mather and Ackerman reported on the status of the National Employment Registry of Agricultural Economists.
10. Bonnen presented a resolution thanking the Texas A&M University for hosting the meeting with the request that copies of the Resolution be sent to appropriate personnel of the University.
11. Bonnen presented a Resolution expressing the appreciation of AAEA to the University of Florida and University of Wisconsin for providing editorial services for the past three years.
12. Discussions were centered around the Board's decision to establish a page charge for the *Journal*. Ruttan moved that AAEA not initiate a page charge and recognize the necessity of a possible dues increase to increase income. Seconded. Hathaway asked for maker to include in the motion to increase the dues to $25 for regular members and $12.50 for students. The suggestion was accepted. After discussion, a standing vote was taken. Motion Lost. A page charge was established.
13. Hillman moved that a committee be appointed to study the economics of the *American Bibliography of Agricultural Economics* and report back next year. Seconded. Passed.
14. Foytik expressing an opinion on the role of agricultural economists in combating inflation moved to direct the President of AAEA to appoint, in the near future, a committee of five members to write an appropriate resolution, including several relevant whereas clauses, expressing the readiness of the AAEA to assist with its economic expertise in the development and implementation of a national policy for effectively combating inflation. Seconded. Passed.
15. Tefertiller expressed appreciation for all those assisted throughout the year and turned the chair over to Nielson who became the new President.
16. Nielson announced the appointments to the nominating committee of which K. R. Tefertiller will be chairman.

The meeting was adjourned at 10:30 a.m.

Respectfully submitted,
JOHN C. REDMAN
Secretary-Treasurer

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